REPORT

OF THE

Department of Scientific and Industrial Research

FOR THE YEAR ENDED

31 MARCH 1959

Presented to the House of Representatives by Leave

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COMMONWEALTH MYCOLOGICAL INSTITUTE
16 SEP 1959

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MINISTER'S STATEMENT

THE reports of the Department of Scientific and Industrial Research and of the Council of Scientific and Industrial Research for the year ended 31 March 1959 are presented herewith.

Members of the council have continued to give much time at meetings and in continuing the review of the work of the branches of the Department by visits and discussions. I appreciate their services and thank them for carrying out the duties required under the Scientific and Industrial Research Act. I particularly wish to record my thanks to Mr D. F. Sandys Wunsch who served as chairman of the council for four years and to Sir Ernest Marsden. Both have completed their terms of office. In their places I have pleasure in welcoming Dr M. M. Burns and Mr R. Slade to the council.

Although the International Geophysical Year ended officially on 31 December last, the Government has decided to continue scientific work in the Antarctic. This will call for a substantial effort by the Department of Scientific and Industrial Research. The general programme and scale of operation is subject to recommendation by the Ross Dependency Research Committee which is directly responsible to me. The first annual report of the committee appears as an appendix to the annual report of the Department of Scientific and Industrial Research.

Productivity of some of our primary industries continues to be seriously affected by diseases of both plants and animals and in this connection there has been progress made in research into the causes of facial eczema. This work involves a number of branches of my Department and it is particularly gratifying to be able to record the very good collaboration which exists between officers of these branches and of the Department of Agriculture.

Early in the year the Government appointed the Atomic Energy Committee as a subcommittee of the Council of Scientific and Industrial Research to advise on the establishment and operation of a nuclear research institute. The Government further approved the expenditure of £240,000 for the first stage of development of the institute. The institute is planned to meet the needs of the Department of Scientific and Industrial Research and other Government Departments and to provide facilities for the universities to conduct research.

As I have stated previously, I am strongly of the opinion that more attention needs to be paid to the application of scientific research and development in our manufacturing industries.

My Department is doing what it can within its resources but further development is necessary. The work of cooperative research associations, which are financed jointly by industry and by the taxpayer through

the Department, is not only being applied to improving the manufacturing processes and quality of goods for local consumption but is also by improvements in processing materially helping to raise the quality and value of a number of exported primary products.

I should like to record my appreciation of the work of the staff of the Department and to thank them for their service during the year.

P. N. Holloway,

Minister in Charge of the Department of Scientific and Industrial Research.

REPORT OF THE COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

The Hon. P. N. Holloway, Minister in Charge of the Department of Scientific and Industrial Research.

We have the honour to submit herewith the report of the Council of Scientific and Industrial Research for the year ended 31 March 1959.

The Council consists of a chairman and not more than eight other members, not more than two of whom may be "officers employed in the service of the Government". The membership of the council at 31 March 1959 was:

M. M. Burns, C.B.E., M.Sc.(N.Z.), Ph.D.(Aberdeen), F.N.Z.I.C. (Chairman).

F. J. Llewellyn, Ph.D., D.Sc.(B'ham), F.R.I.C., F.N.Z.I.C., F.R.S.A. (Deputy Chairman).

J. Andrew, C.B.E.

A. F. Downer, C.B.E., M.I.C.E., M.N.Z.I.E.

J. F. Filmer, D.V.Sc.(Melb.), H.A.R.C.V.S.

C. Hilgendorf, M.A.

R. Slade.

A. H. Ward, A.R.A.N.Z.

J. S. Watt, M.Sc.(N.Z.), D.Phil.(Oxon).

W. M. Hamilton, M.Agr.Sc., D.Sc., N.D.H.(N.Z.) (Secretary).

Mr D. F. Sandys Wunsch and Sir Ernest Marsden retired on rotation on 31 December 1958 and the vacancies were filled by the appointment of Dr M. M. Burns and Mr R. Slade for a period of four years from 1 January 1959.

Five meetings of the council were held during the year, and its various committees met regularly. The council wishes to take this opportunity of expressing its appreciation of the valuable work done by members of its committees.

RESEARCH GRANTS TO BODIES OUTSIDE THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

The council continues to recommend annual grants to research workers in the universities and to other institutions to encourage research, frequently in subjects ancillary to the main programme of the Department of Scientific and Industrial Research.

Each of the two agricultural colleges has, for instance, received grants of from £6,000 to £8,000 annually for some years to support research into a large number of problems concerned with soils, farm plants, and animals.

At the universities the council supports with substantial grants a number of research projects such as radio research at Auckland, research into meteor showers at Canterbury, and the Industrial Development

Department of the University of Canterbury. At Victoria University of Wellington it meets a considerable part of the cost of the special investigations of ironsands.

The grants to universities, including the colleges of agriculture, have for some years amounted to approximately £30,000 annually and moneys so spent enable a large amount of research to be carried on by members of university staffs and others who would be severely handicapped in their work without this aid.

In addition to those for university research, grants are made to allied institutions, to research institutions, societies, and associations. At the Cawthron Institute in Nelson and at the seven incorporated research associations such grants provide approximately half the total funds available.

Altogether, including grants to universities, research institutions, and otherwise, the Council of Scientific and Industrial Research recommends annually the expenditure of a substantial sum, this year over £165,000, to assist research or the work of organisations concerned with research. These grants, although met from the vote of the D.S.I.R., are outside the regular programme of research and scientific services of the Department itself.

Details of grants paid last year are as follows:

Grants Paid in 1958–59 to Research and Allied Institutions

	£	£
Canterbury Agricultural College		8,000
Massey Agricultural College		8,000
Cawthron Institute		10,996
Carter Observatory – Statutory		2,250
Royal Society of New Zealand		5,000
Commonwealth Agricultural Bureaux		18,680
U.K. National Institute of Oceanography		2,500
C.A.S.A.G.I. (IGY controlling body)		250
Royal Society and Nuffield Bursary Scheme		200
Scott Polar Research Institute		100
International Conference of Soil Science		500
Special Grant for Representation at Geneva Conference		100
British Association of Scientific Instrument Makers		120
International Atomic Energy Agency		8,945
Incorporated Research Associations—		
Dairy Research Institute (N.Z.)	33,261	
Meat Industry Research Institute of New Zealand (Inc.)	23,400	
New Zealand Fertiliser Manufacturers' Research Association (Inc.)	4,250	
New Zealand Leather and Shoe Research Association (Inc.)	5,400	
New Zealand Pottery and Ceramics Research Association (Inc.)	5,650	
New Zealand Wool Industries Research Institute (Inc.)	6,600	
Research Institute of Launderers, Drycleaners, and Dyers of New Zealand (Inc.)	4,500	
		83,061
University of Auckland (Seagrove)		4,000
University of Canterbury—		
Industrial Development Department	8,000	
Radio Research (Meteors)	1,750	
		9,750
Victoria University of Wellington: Ironsands Investigations		2,450
Special Soil Investigations		380
		£165,282

SALARIES FOR SCIENTISTS

The council during the year has had lengthy discussions on the vexed question of salaries for scientists. It has been disturbed to see that not only is there a tendency to lose scientists to positions overseas for which salaries and facilities are better than in New Zealand, but also it is becoming increasingly difficult to get recruits of high calibre to fill vacancies and new positions. This applies in the universities as well as in Government Departments.

The main trouble, in the view of the council, is that the salaries offered for the senior positions are relatively much lower compared with similar overseas positions than are the starting and intermediate salaries. For example, the following table shows the comparison between similar positions in New Zealand, Australia, and the United Kingdom. In the last column are given the council's suggestions for new maxima.

	New Zealand	Australia	United Kingdom	Proposed New Maxima
	£(N.Z.)	£(A.)	£(Stg.)	£(N.Z.)
Head of Department	2,760	6,000	7,000	3,500
Chief Scientific Officer (Branch Director) ..	2,260	4,750	3,800	2,800
Senior Principal Scientific Officer	1,860	3,500	2,700	2,200

The council is of the opinion that very serious consideration should be given by the Government to making very substantial increases in the salaries of leading scientists in order to provide an incentive for promising juniors to join and remain with the Department.

While the council recognises that such a move may have repercussions in other classes of the Public Service, it does not consider this a valid reason to refrain from taking positive action to correct the present unsatisfactory position.

RESEARCH ORGANISATION

Council has continued its visits of inspection to the various branches of the Department and will complete this programme in April. Through these visits and discussions with many departmental officers council has secured a much fuller appreciation and understanding of the work being carried out within D.S.I.R.

Council has been impressed with the scope of the Department's activities, the high standard of work and the enthusiasm and initiative of the staff.

The council feels that major modifications of the Scientific and Industrial Research Act 1952 would be desirable and should be considered by Government. With the much fuller knowledge of the work of the Department which the council now has, council will study this matter fully and intends to make recommendations during the coming year.

INTERNATIONAL GEOPHYSICAL YEAR

The IGY ended on 31 December 1958. The programme undertaken by New Zealand was an ambitious one which threw a heavy load on some branches of the Department. The planned programme of observations was completed and most of the data have already been reduced and forwarded to the IGY world data centres.

The IGY was an outstanding example of international collaboration in the scientific field and it is pleasing to note that this international cooperation is continuing in the post IGY activity in Antarctica.

NUCLEAR SCIENCE

In June 1958 Government approved the establishment of an Institute of Nuclear Sciences as a branch of D.S.I.R., to be administered by the Department in collaboration with the University of New Zealand and to incorporate the existing D.S.I.R. Division of Nuclear Sciences. An Atomic Energy Committee has been formed as a subcommittee of council to advise on the policy and programme of the institute.

The first stage in the development of facilities for the new institute involves the installation of a 3 MeV Van de Graaff accelerator and the erection of laboratories. Council hopes that these facilities can be completed by 1961. It is not at present feasible to duplicate in New Zealand some of the more expensive equipment required for nuclear research and the institute is being established to cater for all those having a legitimate need for the use of major items of nuclear equipment.

Council hopes that the new facilities will stimulate nuclear research and training in the universities and permit D.S.I.R. to expand its present programme so that New Zealand can benefit from the rapid advances being made in this field of science.

RESEARCH EXPENDITURE

D.S.I.R. expenditure since 1949–50 is shown in the summary below, together with a column showing expenditure as a percentage of the gross national product (national income).

Year	Staff at 1 April		Gross Expenditure	Gross National Product	D.S.I.R. Expenditure as Percentage of National Product
	Professional	Total			
			£(000)	£(m.)	
1949–50	363	939	959	556	0·173
1950–51	390	981	962	696	0·138
1951–52	386	997	1,096	722	0·152
1952–53	402	1,012	1,010	757	0·133
1953–54	374	931	1,089	841	0·129
1954–55	374	937	1,149	930	0·124
1955–56	372	928	1,213	984	0·123
1956–57	366	946	1,404	1,026	0·137
1957–58	369	972	1,535	1,081	0·142
1958–59	383	1,023	1,658	*	*

*Figures not available

Council draws attention to certain significant features of the above table. During the 10-year period under review, during which time New Zealand's population and the total labour force has increased by over 20 per cent, the professional staff of the Department has increased by 15, or 4 per cent, while the total staff has increased by 83, or 8 per cent.

Gross expenditure of the Department in terms of the national product shows a decrease since 1949–50 but after declining till 1955–56 has recovered slightly during the past three years. Nevertheless, it still remains well below the 1949–50 level. Council regards the relatively static position of the Department in terms of professional manpower and decreased expenditure in "real" spending power (as measured by changes in the value of money) as underestimating the role of scientific research in

the future development of New Zealand. This is particularly unfortunate in that it has occurred during a decade when the needs of our primary industries in meeting and overcoming the growing competition of overseas markets, and of our expanding secondary industries in reaching maximum and self-supporting efficiency, demands increasing research and application of scientific method and knowledge.

DEPARTMENTAL EXPENDITURE AND STAFFING

Expenditure by the Department in 1958–59 is shown in the table below:

Table of Expenditure 1958–59

——	Staff 31 March 1959	Salaries	Other Expenditure	Total Expenditure 1958–59	Voted 1958–59
		£	£	£	£
Head Office	72	61,881	11,876	73,757	73,700
Animal Ecology Section ..	8	7,970	3,332	11,302	11,100
Applied Mathematics Laboratory	18	18,742	1,899	20,641	20,340
Auckland Industrial Development Laboratories	33	30,917	11,790	42,707	46,850
Botany Division	25	22,961	9,459	32,420	32,580
Crop Research Division ..	53	41,269	20,341	61,610	62,110
Dominion Laboratory ..	145	127,424	63,881	191,305	195,520
Dominion Physical Laboratory ..	144	122,752	62,135	184,887	192,700
Entomology Division	26	22,604	10,761	33,365	34,790
Fats Research Laboratory ..	16	15,750	5,810	21,560	21,080
Fruit Research Division ..	27	25,215	25,139	50,354	48,670
Geological Survey	79	70,188	26,171	96,359	90,690
Geophysics Division	86	79,560	85,305	164,865	158,120
Grasslands Division ..	77	59,207	41,938	101,145	99,900
Hop Research Station ..	4	3,663	3,538	7,201	7,700
Information Bureau	23	18,962	35,805	54,767	50,170
Nuclear Sciences, Division of ..	26	23,418	14,517	37,935	34,920
Oceanographic Institute ..	20	17,860	14,116	31,976	32,380
Plant Chemistry Division ..	26	22,612	15,271	37,883	38,700
Plant Diseases Division ..	60	54,301	27,261	81,562	80,880
Scientific Liaison Service ..	6	11,974	4,210	16,184	16,580
Soil Bureau	73	72,253	26,623	98,876	95,070
Tobacco Research Station ..	7	5,709	4,301	10,010	12,090
Wheat Research Institute ..	11	10,580	3,226	13,806	13,560
Research General	..	..	10,064	10,064	10,800
Scholarships	..	..	5,792	5,792	7,700
Miscellaneous	..	..	534	534	500
Grants—					
Universities and agricultural colleges	..	..	32,200	32,200	32,200
Incorporated research associations	..	..	83,061	83,061	83,061
Statutory and miscellaneous ..	..	..	50,021	50,021	49,039
	1,065	947,772	710,377	1,658,149	1,653,500
Less recoveries	..	..	..	54,937	52,890
Net expenditure ..	..	..	..	1,603,212	1,600,610

The actual staff employed on 31 March 1958 was 1,023 and by 31 March 1959 this had increased to 1,065.

The staff at 31 March 1959 (figures for previous year in parentheses) comprised professional 390 (383); clerical 175 (165); technical 435 (410); others 65 (65).

M. M. Burns, Chairman.

SECRETARY'S REPORT

The Hon. P. N. Holloway, Minister in Charge of the Department of Scientific and Industrial Research.

I have the honour to submit herewith the annual report of the Department for the year ending 31 March 1959.

In June, Government approved the establishment of an Institute of Nuclear Sciences as a branch of the Department to be administered in collaboration with the university. The institute will incorporate the existing Division of Nuclear Sciences. An Atomic Energy Committee was appointed as a subcommittee of the Council of Scientific and Industrial Research to advise on the administration and programme of the new institute.

A New Zealand delegation of five members attended the Second United Nations International Conference on the Peaceful uses of Atomic Energy held 1–13 September 1958 at Geneva. Subsequently, two members of the delegation visited nuclear research establishments in Europe and North America. On their return they reported to the Atomic Energy Committee on equipment and the design of facilities for the new Institute of Nuclear Sciences.

The position of director of the institute was advertised in New Zealand and overseas and the appointment should be finalised shortly.

It is intended that the institute should be located in the Wellington area and data on suitable sites are being collected and sketch plans prepared for the necessary buildings.

Approval was also given during the year for a design and cost study of controlled climate facilities (phytotron) which it is hoped to erect at Palmerston North.

Good progress has been made on the new building for Botany Division at Lincoln and the building is expected to be occupied later this year. The plans include provision for adequate herbarium and library space as fireproof as possible. The building will also provide space for officers of the Entomology Substation and the Grasslands Substation at Lincoln.

Tenders are expected to be called shortly for completion of the Dominion Laboratory buildings at Gracefield. These, when occupied, will complete the move of Dominion Laboratory from the Sydney Street site.

Plans are also being prepared for a new building at Taita to house Soil Bureau and it is hoped tenders will be called later in the year.

A number of research units, however, are still housed in make-shift and unsuitable accommodation. Government have recognised this by making a larger allocation to the Department for new buildings during the coming year. This increase in the tempo of new building is very welcome and must be maintained for some years to overcome arrears and provide for new developments such as nuclear science and controlled climate facilities.

STAFF

During the past six years there has been considerable reorientation of the work of the Department. The Department's work in oceanography, nuclear science, geothermal investigations and facial eczema research have all been strengthened while the IGY and our continuing activity in Antarctica have made increasing demands on manpower and facilities.

At 31 March 1959 the Department was employing 390 professional staff an increase of seven during the past year but still fewer than the average of the three years 1950–52 (average 393). New Zealand is probably the only country in the western world employing fewer scientists in its major governmental research organisation today than in 1952. The scale of our scientific effort is important because it will, in large measure, set a limit to our ability to employ new and more efficient techniques in both primary and manufacturing industry.

RESEARCH

In the following section a brief review of work completed during the year is given. Items that appear to be of general interest have been selected and are outlined in non-technical terms with sufficient background information to explain the significance of the work. No attempt has been made to cover all work completed, but a complete list of scientific papers published during the year is given following the list of projects in each branch.

FACIAL ECZEMA RESEARCH

The Soil Bureau since 1954 has been investigating the microbiology of New Zealand soils, particularly those under native and introduced grassland and under native forest. Much information has been gathered of the species of micro-organisms present in various soils and of their distribution as influenced by vegetation, season, and other factors. As certain species in soils under pasture showed marked responses to the influence of season it appeared possible that soil micro-organisms might be associated with seasonal stock diseases such as facial eczema. This view had been considered in 1938 by other investigators but had been abandoned for lack of direct evidence. The initiative in a re-examination of this aspect was taken by the Soil Bureau.

Investigations were begun in February 1957 with the cooperation of officers of Ruakura and Wallaceville Animal Research Stations of the Department of Agriculture; Claudelands Showgrounds, Hamilton, an area of known facial eczema history, was selected for initial studies. It was not known whether a soil micro-organism was involved in this disease and therefore the investigations were carried out as part of the broader investigation by the Soil Bureau of other forest and pasture soils being examined at the same time. Micro-organisms on pasture plant leaves were also examined in order to establish the relationship between soil and leaf microbial populations. It was also possible that organisms on pasture leaves could cause ill health in grazing animals.

Many hundreds of micro-organisms were isolated, examined, and identified from samples collected during these investigations and from samples sent from Ruakura Animal Research Station. Several organisms, including fungi, yeasts, and bacteria were selected for preliminary screening by animal feeding trials and a chemical test known as the

"beaker" test, but were shown to have no relation to facial eczema. In 1958 work was concentrated on a fungus, spores of which, obtained from Claudelands Showgrounds, had been shown by Ruakura Animal Research Station to give a positive result in the "beaker" test. Preliminary trials with a low sporing strain of the fungus, *Sporidesmium bakeri,* grown in the laboratory, however, were apparently negative. From large numbers of spores later found on toxic grass samples a high sporing strain was isolated and tested and found to give a positive result in the "beaker" test. Further investigations established suitable media and conditions for good growth and spore production by the fungus. When cultures of the high sporing strain of fungus were fed to experimental animals at Ruakura Animal Research Station liver lesions were produced which were considered to be characteristic of those produced by the facial eczema toxin.

Spores of *S. bakeri* have been found in pasture in several districts in both North and South Islands, although their numbers in the north are much greater than in the south.

Further cooperative investigations at Manutuke Research Station, Department of Agriculture, have established a relationship between facial eczema disease of sheep in the field and the fungus *Sporidesmium bakeri.*

It has been established that *S. bakeri* is a widespread saprophyte which colonises dead material of a large variety of plants and is a common invader of litter in pastures. For optimum growth it requires relatively high temperatures and moist conditions. From the collection of isolates which is being built up at the Plant Diseases Division it appears that there may be several strains of the fungus. In collaboration with the Animal Research Station at Ruakura a number of isolates are being tested for relative toxicity. By this means it is hoped that a high toxin-producing strain will be discovered as this would facilitate chemical extraction of the toxin.

Pure spores of the fungus produced at the Plant Diseases Division have been proved highly toxic at Ruakura and a satisfactory technique has been evolved for bulk production of spores for chemical work with the toxin.

To assist in field studies with the fungus a spore trap has been developed by Plant Diseases Division for rapid sampling and determination of the relative abundance of *S. bakeri* in pastures.

Grasslands Division has been investigating the environmental conditions favouring rapid growth and sporing of the fungus under controlled glasshouse conditions. A collaborative study of the weather conditions preceding outbreaks of facial eczema has been made in conjunction with the Economic Service of the New Zealand Meat and Wool Boards and the Meteorological Office. A paper summarising these investigations will be published shortly. Sweet vernal (*Anthoxanthum odoratum*) has been shown to contain a substance which inhibits the growth of *S. bakeri.*

Plant Chemistry Division has been cooperating with the Ruakura Animal Research Station by undertaking preliminary extraction and concentration of toxic material for chemical investigation at Ruakura. The Fats Research Laboratory and the Dominion Laboratory have also been contributing their specialised knowledge on certain chemical aspects of the constitution of the toxin.

In order to ensure coordination of all work proceeding on facial eczema research, regular meetings of the research workers concerned are being held.

HOGGET ILL THRIFT

"Hogget ill thrift" is the term given in New Zealand to a wasting condition of hoggets which leads each year to considerable stock losses and to reduced animal production throughout the country. The disorder arises from the unsuitable chemical composition of the herbage the animals are grazing and in some cases it can be corrected by supplying appropriate trace elements. In the majority of cases in the North Island, however, the condition commences when hoggets graze lush autumn pasture growing rapidly after the onset of autumn rains and it cannot be alleviated by known trace elements. Work on the chemical composition of this autumn pasture has been carried out since 1957 at Plant Chemistry Division.

The most obvious characteristic of such herbage is found to be the relatively high content of nitrate, which rises to maximum levels when "flushes" of growth follow lengthy dry spells. There are clear-cut differences in chemical composition between pasture species, with the high fertility grasses such as the ryegrasses tending to have the highest nitrate levels. The levels fluctuate rapidly with changes in environmental conditions such as light, temperature, and rainfall.

In ruminants, the rumen micro-organisms can, under certain conditions, produce appreciable quantities of nitrite and hydroxylamine from nitrate, both of these products being toxic to the animal. Rapid variations in the level of nitrate in the feed cause greater distress to ruminants than steady feeding at one level, so that the marked variations which are observed in the herbage in the field are important. A consideration of the general features of "nitrate poisoning" and "hogget ill thrift", however, makes it clear that though nitrate may be a partial cause of "hogget ill thrift", it is not the whole explanation. On the other hand, the nitrate content of pasture does appear to be a good indication of pasture which will cause "ill thrift".

Attention has, therefore, been centred on other chemical constituents of the herbage and, in collaboration with Dominion Laboratory, an organic fraction containing amino and nitro-groups has been isolated. The compounds in this fraction are being identified and herbage is being processed on a pilot-plant scale for toxicity testing.

This work is seen as part of a long-term study of the chemical factors which influence quality of herbage for animal production.

LONG-ROTATION RYEGRASS

At Grasslands Division selection has just been made of the group of parent plants to be used for the first nucleus seed supply of the new long-rotation ryegrass. These parent plants will be used for small-scale glasshouse increase and also, by favour of Massey Agricultural College, a well isolated area there will be planted in cuttings to produce an early seed supply for field trials. Selection of these parents is the final job after a period of many years of selection and progeny testing at the Division's four regional stations at Kaikohe, Palmerston North,

Lincoln, and Gore. The aim has been to produce a ryegrass with the persistency and rugged nature of the true perennial, plus the greater palatability of the present short-rotation ryegrass. In the original crossings some 10 years ago, selected parents from these two strains were used. Since that time a very large and detailed programme of progeny performance under grazing has been carried out.

Results at all stations are very encouraging both on the single plants and on small-scale sward comparisons with the best of the present regional strains, and also with the true perennial and short-rotation. Interest is also aroused by the comparative resistance of this new strain to attacks of the Argentine stem-weevil which have, in the last few years, been an increasing danger to the palatable and relatively low-tillering short-rotation ryegrass. This resistance, together with excellent summer persistence, and its density in the sward, should make the new strain an extremely acceptable plant throughout the country. Considerable work still needs to be done however in relation to its suitability for the grazing animal.

ARGENTINE STEM WEEVIL (*Hyperodes griseus* Hust)

This pest which has been known in New Zealand since 1927 has in recent years become a serious trouble in ryegrasses. Short-rotation ryegrass (H. 1.) has been most severely affected. Italian ryegrass is also damaged but perennial ryegrass, although attacked, does not appear to be nearly so badly affected. Damage is done both by adults and larvae. Adults strip either the upper or lower surface of the leaves but usually leave the cuticle on one side with the result that attacked leaves possess a typical silvery appearance (rather similar to that due to slug damage). More severe damage however, is caused by the tunnelling of larvae in the tillers; this injury results at first in wilting of the plant, followed by browning and often death. At this stage the damage looks rather superficially like that caused by grass grub but in the case of the weevil the root system is undamaged. Larvae will also tunnel up the stems of seed heads and in such cases the result is a "white head" that does not set seed. It has been known for a year or two that the weevil was widely distributed over the North Island and in several areas of the South Island. In the South Island it has been seen to damage short rotation ryegrass for the past two years at least but it was only last season that it showed its capabilities in the North Island. Last summer severe damage to this ryegrass was reported in North Auckland, Waikato, King Country, South Taranaki, Rangitikei, and Manawatu. There is a school of opinion that last season's epidemic was related to the climatic conditions but it cannot at this stage be predicted how serious the weevil will be from season to season. It is fortunate that perennial ryegrass does not appear to be seriously affected. The life cycle of the weevil in the South Island has been investigated as a preliminary to chemical control. There are already indications that the use of DDT and BHC, particularly the former, if applied at the appropriate time indicated by the life history, shows promise against adults. The use of certain systemic insecticides aimed at killing larvae in the plants has given disappointing results. There is a strong possibility that the weevil might be controlled by natural enemies introduced from its native land and this aspect is being actively investigated by the Entomology Division.

OAK LEAF MINER (*Lithocolletis messaniella* Zell.)

This insect has caused much damage to the foliage of oak trees in New Zealand since 1951. The larva mines in the leaves and gives these an unsightly and wholly unattractive appearance. Exotic beeches and chestnuts have also been attacked and the pest has been noted even on native beech. This last attack represents a potential danger to our indigenous forests but fortunately so far such damage has been very rare. The desirability of retaining introduced trees such as oaks, beeches, and chestnuts in their usual attractive condition, together with the fear that there might be some chance of the pest developing a liking for certain indigenous trees, prompted action towards control. The application of insecticides to trees such as oaks under the conditions of distribution occurring in New Zealand is impracticable. The best hope lay in biological control and the fact that the miner is always at a very low population density in Europe and Asia, the areas of its origin, suggested that it was held in check in these places by some natural means. With the assistance of the Commonwealth Institute of Biological Control two parasites were imported by the Entomology Division from Europe. One is active during winter and summer while the other is a summer parasite only. It would appear that the winter parasite has a decided advantage in that it is able to parasitise the leaf miner on evergreen oaks during autumn and winter. The winter parasite was liberated in Nelson in the autumn of 1957 and the summer one in the spring and early summer of the same year. Both established.

A survey in the Nelson liberation area in the season just past indicated that the percentage of parasitism by the two insects introduced is approximately 74 per cent and of this parasitism the winter parasite accounts for 85 per cent. This percentage of parasitism in such a short time is very encouraging and there is every indication that damage caused by the leaf miner will be reduced to insignificant levels. The winter parasite has been distributed over both the North and South Islands and reports of establishment have been received from some localities.

BITING FLIES

The increasing incidence of the biting fly *Stomoxys calcitrans* L. in New Zealand has been causing concern to dairy farmers in some North Island districts. The fly, which can seriously affect production by irritating stock to the point of acute fatigue, has been present in New Zealand for a long time. In recent years it has increased so sharply that it has become an urgent problem. During the past season basic information has been obtained on the breeding sites of the fly. A comprehensive survey of the main ensilage producing areas of the North Island by the Entomology Division has shown conclusively the importance of ensilage stacks as breeding sites for this pest. Control of the fly by elimination or reduction of breeding sites is considered better than depending on insecticide protection of stock against it. Future work will be conducted to this end with a view to finding a practical solution to the problem. To date, the use of insecticides on breeding sites has not proved satisfactory as a method of control.

BORER CONTROL IN PLYWOOD

Infestation with the common house borer (*Anobium punctatum*) is a major cause of wood deterioration in New Zealand and plywood is particularly susceptible to borer attack. As pre-treatment of veneers with preservatives was found to be impracticable in the Dominion an investigation was begun by the Plant Diseases Division in 1954 to determine the effectiveness of residual contact insecticides incorporated in the glue line. Because of its greater chemical stability under hot pressing conditions dieldrin was chosen for the tests. With the cooperation of one of the major plywood manufacturers a series of three-ply panels of kahikatea veneer, $\frac{1}{16}$ in. and $\frac{1}{10}$ in. thick, were prepared using casein u-F and P.F. resins in which dieldrin was included at nine rates between 0·025 per cent and 4 per cent of glue weight. These, together with a comparable set of panels without dieldrin, were exposed to *Anobium* attack, first in 1954–55 season and again in subsequent seasons. To date only the untreated panels have become infested. Although it was too early to draw conclusions about the permanence of dieldrin in the glue, the need for borer protection of plywood was so great that it was decided to recommend the manufacturers to incorporate 0·25 per cent dieldrin in glue for plywood. The recommendation has been accepted and the incorporation of dieldrin in the glue has become standard practice in the plywood industry. The test panels will continue to be exposed to borer attack annually in order to secure a measure of the expected life of the treatment.

GROWTH OF APPLE TISSUE IN STERILE CULTURE

Last year it was reported that Sturmer apples which keep well in store have small cells, while the poor keepers have big ones. Clearly the next step was to find something that would stimulate cell division in growing apples to make them keep better, and there is some evidence that this has already been achieved on a small scale. A great deal of work is necessary before the method can be tested on a field scale. This promised to be a very long job, as all cell division in a young apple occurs during the three weeks after full bloom. From then on cells simply swell like balloons.

If, however, apple tissue could be made to grow in sterile culture, young, dividing cells would be available for experiment all the year round. After 18 months' work a satisfactory technique has been developed by the Fruit Research Division, and apple tissue can now be grown in test tubes whenever it is wanted for experimental purposes. Some other plant tissues have been grown under similar conditions for years past, but this is the first time on record that success has been achieved with apple.

Now, between blossoming seasons, many substances are being tested for possible effects on cell division. When a response is obtained with one of them, the best concentration can be worked out in the laboratory, so that only the most promising treatments need be applied in the field during the critical three weeks each spring.

THE APPLEBY ORCHARD EXPERIMENTS

In 1930 an extensive series of fertiliser trials was laid down on the Appleby Research Orchard in the Nelson district. This in itself was not remarkable, but these experiments have earned a special place for

themselves in scientific records as they were maintained for 26 years and the apples produced were followed through into cool store. Detailed results for the whole period have just been published jointly by the Applied Mathematics and Fruit Research Divisions. Although unlikely to rival a best selling novel, the bulletin will arouse wide interest in the fruit world as it adds considerably to our knowledge of the effect of fertilisers on tree growth, yield, and storage quality of the crop.

Highlights of the results are as follows: Trees on poor Moutere Hill clay, which is the main orchard soil of Nelson, were still yielding three bushels of apples after 26 years without any added fertiliser, but top-dressing with nitrogen, phosphate, and potash nearly doubled this yield. When these three fertilisers were used singly nitrogen was the only one to produce a response, but once nitrogen was supplied successive increases in crop followed the use of the other two. These larger crops kept well in cool store, provided all three minerals were supplied. Where nitrogen was used alone storage quality was poor.

A NEW APPLE ROOTSTOCK GOES INTO SERVICE

New Zealand's traditional apple rootstock, Northern Spy, lost its pre-eminence in 1945 when the fruitgrowers' cooperative nursery at Levin started to supply the vigorous East Malling stocks No. XII and XVI. These were introduced from England by this Department 15 years previously to overcome the problem of Northern Spy, which will not produce a good tree on a site where another tree on this stock has been growing, and also to produce bigger trees of varieties that do not grow strongly on Spy. Both stocks have done well, and are playing an increasing part in the steadily climbing figures for apple production. But Malling XVI is not well suited to poor clay soils, and the search was continued for a more versatile stock of similar vigour. This has been successful. Another English stock, the MM 793, has proved at least as good as M XVI on good soils, and decidedly superior on poorer orchard country. It will produce a good tree when planted in a hole formerly occupied by another on Northern Spy, and it can be raised easily in the nursery. MM 793 is now being grown in quantity at Levin. The first batch of trees on the new stock were budded this autumn and will be planted out in 1960.

VIRUS DISEASES OF FRUIT TREES

For a number of years the virus diseases of pip and stone fruit trees have been under investigation by the Plant Diseases and Fruit Research Divisions. During the investigations 19 distinct viruses have been recognised. Most of these are known to occur in other countries, but at least two do not appear to have been reported from overseas.

A number of these virus diseases are widely distributed and have a high incidence in the Dominion. Although only a few cause complete loss of crop they are, over all, of considerable economic importance as they cause marked reductions in yield.

The most common of the fruit tree viruses occurring in New Zealand are apple mosaic and plum mosaic. The former is of such high incidence that it has not been possible to find mosaic-free trees of several popular varieties. This virus occurs in a large number of strains which vary greatly in the intensity of symptoms they produce. Preliminary trials

using a severe strain have shown that it causes reduction in tree growth and a marked reduction in yield. Mild strains have much less effect and give trees a strong protection against severe strains. Incidence of plum mosaic is not as great as that of apple mosaic, but even with this virus difficulty has been experienced in finding clean trees of one common variety. Yield trials with plum mosaic have shown that the disease reduces tree growth, and for the first three years of cropping yield of infected trees was only half that of the healthy trees.

Two of the most damaging fruit tree viruses, plum fruit crinkle and Moorpark mottle of apricots, were of low incidence and an attempt was made to eradicate them. Eradication attempts appear to have met with some success as no further infected trees have been discovered during the past three years.

With the assistance of the Department of Agriculture much has been done to reduce virus infection in root-stocks in nurseries and considerable effort has been put into the selection of virus-free budwood trees. This means that there has been a marked reduction in the number of virus-infected young trees reaching orchardists.

RIPE SPOT OF APPLES

Ripe spot is the common name for a circular rot often prevalent on apples which have been stored for some time. Two fungi, *Gloeosporium perennans* and *G. album,* each cause ripe spot. One, *G. perennans,* lives in stem cankers on apple trees and spores from these infect the fruit. *G. album,* on the other hand, rarely attacks twigs or branches of apple trees but establishes itself on a wide range of other hosts, producing spores which infect apple fruits. In both cases the rots caused by these fungi on apples do not usually appear until several weeks after the fruit has been picked.

When information had been accumulated on the biology of the fungi, work was concentrated on orchard spraying to control the disease and a satisfactory programme has been developed. This includes several applications of phenyl mercury chloride in spring to inhibit spore production by *G. perennans* on stem cankers, and regular spraying with captan through the summer to protect fruit from spores of both species.

CARROT MOTTLEY DWARF VIRUS

An aphid-carried virus disease of carrots identified as carrot mottley dwarf has recently been found in New Zealand. The disease appears to be widely distributed and field trials carried out by the field crop section of the Plant Diseases Division at Lincoln have shown that it is responsible for serious reduction in yield and quality of early carrots.

It has been shown that the varieties Yates' Top Weight and Sweetcrop (Holmes' Improved selection) are field resistant, while the varieties Chantenay, Early Nantes, Early Horn, and Manchester Table are susceptible.

At Lincoln severe infection occurred only in early sown (September) carrots. In such early sown crops good control of the virus was obtained by fortnightly spraying with methyl demeton (metasystox) from mid-October.

THE FREEZING POINT OF PEARS

Freshly picked fruit is still a living organism which continues to mature and for storage purposes this rate of maturation must be reduced. This is best achieved in practice by lowering the temperature, the limit being set by the appearance of various low temperature disorders.

Pears, unlike apples, do not suffer low temperature breakdown, and may be cooled to just above their freezing point, but not below it. It is therefore important to know just what the freezing point of pears is.

In seeking a reliable method for the routine measurement of this point, it has been necessary to study the precise mechanism of freezing. Detailed investigation by the Auckland Industrial Development Laboratories has revealed the following picture.

The pear freezes at a temperature below 32°C for two reasons. The first is that the salts and sugars in solution depress the freezing point by an amount proportional to the concentration. The second is that mechanical pressure on the juice depresses it still further.

This mechanical pressure is the sum of contributions from various sources. The walls of individual cells, and the skin and structure of the whole fruit, each exert some effect as also does expansion of the flesh on freezing. This means that the freezing point is likely to vary with different varieties of pears and at different stages of ripeness. It will also vary from core to skin and depend on whether or not other parts of the pear have already frozen.

The significance of all this is that when the cool store engineer wants to make a practical measurement of the freezing point of his fruit, it is the initial freezing point of flesh near the core that is required, since this is the highest temperature at which freezing can begin.

VEGETABLE IMPROVEMENT

The Vegetable Section of the Crop Research Division was set up in 1947 to function similarly to the other crop sections of the Division in the field of plant improvement. Up to 1952 the main work of the Section was devoted to survey work on varieties, mainly variety trials and trials of strains within varieties. From this work it became obvious that there was wide variation both within and between strains of the main varieties in use and that strains from any one source of supply varied from year to year. It was obvious by selection and seed production in a strain of Savoy cabbage, variety "Best of All," that this year-to-year variation could not be attributed to season.

The results of these initial surveys enabled the research programme to be redefined and this was done in consultation with the Horticultural Division of the Department of Agriculture, the Plant Diseases Division of the Department of Scientific and Industrial Research, and the growers' organisation.

One of the main limiting factors in vegetable production is disease. Chemical control of many diseases is highly successful, but adds appreciably to the cost of production, and is dependent on the efficiency of application, weather conditions, and machinery. The use of disease resistance is a natural sequence to chemical control. A programme of breeding for disease resistance was therefore initiated and was based on considerations of:

(1) The important economic diseases;

(2) The availability of resistance or resistance genes to the diseases; and

(3) The mode of inheritance of the resistances.

With larger scale production and mechanisation of many growing procedures, the lack of uniformity in maturity has become a problem, especially in cabbages, cauliflowers, and other brassicas. With the survey work already done, it was possible to continue with selection in certain material to demonstrate that this problem could be overcome.

The usual plant breeding procedures were adopted in pursuance of these objectives, viz—

(a) Plant introduction – especially for required resistance genes;
(b) Selection within varieties; and
(c) Breeding including hybridisation – the improvement of varieties with specific objectives.

A considerable amount of allied investigation has been accomplished – inheritance of desired characters, propagation methods, seed production problems. The Plant Diseases Division have collaborated in many aspects of the problems of breeding for resistance.

It was realised that the plant improvement programme could only be confidently carried out if there were some method of releasing the products of it, and ensuring a continuous source of pure seed.

Following consultation with the Department of Agriculture, growers, and seed merchants, the vegetable seeds agreement was inaugurated and finally ratified in 1956. Under this agreement nucleus seed is produced by the Crop Research Division, increased under the supervision of the Horticultural Division and finally distributed by merchants as Government approved seed.

The following improved varieties have been released from the Division through the scheme:

Cabbage, Early Savoy, "Best of All" variety—This strain was produced by selection within the variety and was released in 1956. It is considered the most uniform of its type. Continuous selection which has maintained the standard has convinced the seed trade and the industry of the efficacy of the plant improvement scheme.

Cabbage, Late Savoy, "Omega" variety—The release in 1958 of this strain produced by selection within the variety has catered for the maturity range required in the Savoy type.

Carrot, "Sweetcrop" variety—The release in 1956 of this strain selected from within the agricultural variety "Holmes' Improved" stimulated the interest of seedsmen in providing varieties suited to home gardening.

Pole Bean, shiny podded, "Fardenlosa" variety—This selection from within a local variety was released in 1957 and has provided a pure and continuous stock of a market premium type.

Pole Bean, rust resistant, "Westralia" variety—The release in 1956 of this selection from within the variety has provided a uniform strain with the resistance to rust essential in late bean production.

Glasshouse Tomato, leaf mould resistant, "V-548" variety—This strain was selected from a Canadian introduction and was released in 1959. In addition to resistance to leaf mould the strain exhibits other valuable qualities especially blotch resistance and ease of plant handling.

Garden Pea, wilt resistant "Greenfeast" and "Onward" varieties—The "Greenfeast W.R." variety was produced by selection and released in 1957. The wilt resistant character was incorporated in the "Onward" variety by breeding and the resultant "Onward W.R." strain was released in 1959. Both strains have wilt resistance combined with seed yield and market pea yield equal to that of the original varieties.

Field Pea, wilt resistant, "Blue Prussian" variety—This selection was released in 1957 and has proved resistant to wilt in New Zealand and the United Kingdom.

WEED FLORA OF NEW ZEALAND

Associated with the identification of the weed flora of New Zealand is the important practical aspect of the actual ways by which weeds are incidentally or intentionally introduced into the country. Since its founding, Botany Division has investigated this economically significant aspect, has drawn the attention of the appropriate authorities to newly arrived plants which are potentially serious weeds, and pointed out the responsibilities of growers of cultivated plants likely to become weeds if they "escape".

The probable introduction of *Brassica tournefortii* (Mediterranean mustard) to Timaru several years ago in imported grain led to investigation. Railway sidings about Christchurch where Australian wheat is handled showed not only Mediterranean mustard present in every instance, but also two other cruciferous weeds – *Carrichtera annua* (native from Canary Islands to Persia) and *Sisymbrium erysimoides* (native of Abyssinia and Arabia), neither of which had previously been found in New Zealand. Both plants are locally adventive in South Australia, indicating the probable source of some at least of the imported wheat, this being subsequently confirmed by the records of the Wheat Committee.

The appearance several years ago on a North Auckland farm of *Stachytarpheta jamaicensis* (Jamaican vervain) indicated, in conjunction with the history of the particular paddock, that this weed may have been introduced in imported unprocessed fertiliser. Careful watch by the farmer, following continued use of the fertiliser, resulted this year in submission of six tropical weeds not previously known in New Zealand – *Alternanthera repens* (khaki weed, a particularly troublesome weed of warm areas, resistant to all types of weedicides in all except the seedling stage), *Amaranthus* sp., *Euphorbia hirta* (spurge), *Gomphrena* sp. (globe amaranth), *Phyllanthus niruri* (spurge) and *Vernonia cinerea* (iron weed). The appearance of these weeds only on particular paddocks and their occurrence in the area where the fertiliser originated, make it very probable that they were introduced with the fertiliser.

The recent recording of 109 species, eight varieties and six hybrids found as garden escapes or garden outcasts, some now well established and troublesome weeds, indicates the significant contribution of horticulture and related rural activities to the weed flora of New Zealand. This number is additional to the already known large (24 per cent approx.) and significant contribution of horticulture to the weed flora, of which *Eichhornia crassipes* (water hyacinth), *Homeria breyniana* (Cape tulip) and *Oxalis* might be exampled. Of the new plants recorded, some 16 species are well recognised as toxic to livestock, and include

Cestrum, Datura (thorn-apple), *Euonymus* (spindle tree), *Hypericum* (St. John's wort), *Nerium* (oleander), *Nicotiana* (tree tobacco), *Rhododendron* and *Solanum*. The attention of the major horticultural bodies has been drawn to this serious position in relation to agriculture, and the urgent necessity not only to prevent escape and establishment of horticultural plants, but to exercise extreme care in choice of ornamentals for planting in particular sites, and in introduction of new plants from overseas.

EELWORM IN BROWNTOP

Following the reporting of a European eelworm (*Anguina agrostis*) in this economically significant adventive grass, observation has shown that the eelworm occurs on this host in North Canterbury over an area from Oxford and Cust in the north to Hororata in the south, and westward from Racecourse Hill to Lake Lyndon. It was also noted inland from Timaru, but appeared to be absent from coastal districts of Canterbury.

Infected plants of browntop have been sent to England to facilitate research on methods of fumigation of browntop seed containing eelworm galls.

HOP RESEARCH

Cuttings from three seedlings which have been selected for their superiority to the commercially grown Californian variety in yield, quality, and susceptibility to root rot have been grown in a propagation garden which was established at the Marsden farm of the Cawthron Institute. Multiplication in this way will ensure that there will be a limited supply of cuttings of the new varieties available to growers in the spring of 1960. Samples have been submitted to leading brewers and all three are considered satisfactory for brewing.

A programme of backcrossing seedling material to the Californian variety has been undertaken and is producing some outstanding material.

The English variety, Bullion, which at one stage appeared to have promise under New Zealand conditions has been abandoned owing to its low yield.

Considerable progress has been made in studying the response of the hop plant to environmental factors, especially light and temperature. The effects of these two factors on cell multiplication and growth give leads towards understanding the results of ploughing on and ploughing off, the reasons why late training is essential for good yields, and why any extension of the hop-growing area should be towards the south where summer days are longer.

TOBACCO RESEARCH STATION

In the production of tobacco it is attention to detail that makes the difference between an average crop and one which will result in above average returns. Three possible improvements in handling the crop can be put into effect by the grower at little or no cost, thus increasing his net proceeds. The number of plants per acre influences both yield and quality of leaf. In general, yield increases with a greater density of planting, while conversely quality falls away, due chiefly to the smaller size of leaf with the closer plantings. Trials have indicated that a stand of between 7,000 and 8,000 plants per acre gives the best return, taking

into account both yield and quality. Mosaic is still a widespread disease of the tobacco crop, and although not so destructive as in former years, takes its toll of individual crops. Mosaic is spread by handling at any stage of growth, and trials have shown that the present method of tractor intercultivation which seeks to reduce costs by keeping hand hoeing to a minimum, can be an important agency in spreading the disease. Furthermore it has been demonstrated that where cultivation is carried out carefully, without the implement actually touching the leaves of the plants, the spread of mosaic can be kept to a minimum, thus reducing an unnecessary loss in both yield and quality. The use of a variety to suit the grower's local conditions can contribute greatly towards the success of the crop. The station now has available varieties resistant to diseases such as black root-rot and mosaic; varieties suitable for different levels of fertility, and also showing some adaptability to varying climatic conditions. None of these refinements in cultural practices is spectacular, but their combined effect can be considerable, demonstrating the need for continued research into the everyday handling of the crop.

DENTAL CARIES — SOIL TYPE PROJECT

The incidence of dental caries in children up to the age of about 10 years has been found to be considerably lower in Napier when compared with Hastings prior to the introduction of fluoridation. The Napier earthquake resulted in the draining of previously saline soils and the raising of part of the lagoon floor, so that a considerable area of the soils around Napier have a recent marine history. A number of market garden soils in the Napier and Hastings areas have been analysed by the Soil Bureau and differences found which can be attributed to the marine influence in Napier. These soil differences are reflected in the composition of vegetables from these areas, especially trace elements. While the full range of trace elements has not as yet been completed, it is noticeable that molybdenum is higher in vegetables from Napier. This study is being extended to see if these soil and plant differences are reflected in animals, especially the bones and teeth.

ALUMINIUM ORE IN NEW ZEALAND

During a survey by Soil Bureau of the mineral colloids in New Zealand soils, low grade aluminium ore was found to cover large areas. It occurs as it does at Hawaii in the subsurface clays of mature soil types derived from deeply weathered basic rocks. Two samples were of high quality, and in cooperation with Geological Survey a search for areas of high grade ore is being made.

The production of aluminium from its ores is a very costly process; transport and power being the main items of cost. The bulky ore has often to be transported many thousands of miles to the refining plant which must be located close to a source of electric power. Huge quantities of power, in excess of 20,000 kilowatt-hours per ton of aluminium produced, are required in the process. The deposits in New Zealand are easily accessible. They occur on easy rolling country in well roaded areas which are only a few miles from a deep-water harbour. If relatively low-cost electric power is available, New Zealand may be able to develop her own deposits.

WILDLIFE RESEARCH

A study of the role of parasites in the natural control of rabbit populations by the Animal Ecology Section has shown that 21 species of parasites occur in wild rabbits in New Zealand. Some of these parasites, particularly the microscopic Coccidia which occur in the liver and intestines, are important causes of mortality when rabbits are numerous. For instance, an experiment carried out in Hawke's Bay showed that more than three-quarters of the young rabbits born had died before they were four months old; coccidiosis was an important cause of this mortality. Three species of nematode worms are common in rabbits, but the numbers of these parasites are usually held in check by the resistance of the host. Sometimes this resistance breaks down and the worms may then increase to levels that cause harm to the host; more than 20,000 worms have been recovered from some rabbits.

The present study has confirmed that rabbits living in dense populations have more parasites than rabbits living under less crowded conditions. Levels of parasitism in light populations of rabbits are rarely high enough to cause any appreciable mortality. Thus, although in the past certain parasites have been important in providing a check to the further increase of rabbit populations that were already heavy, these parasites are of little value in securing a further reduction of the few rabbits that survive in most rabbit board areas today.

Inter-relationship of Cats, Rats and Petrels. Both wild cats and rats are known to be present on the Little Barrier Island bird sanctuary and the proper management of the island as a sanctuary requires an understanding of the relations of these two animals to the birds, and this has recently been studied. The rats there were found to be Maori rats or kiore which do little harm to the birds. The food of the cats was determined by examining faeces collected in winter and summer. During the summer the cats are mainly feeding on Cook's petrels which nest there in very large numbers; in the winter they have a more varied diet in which rats are the most important item, a number of small birds are also taken but no one species is particularly selected. The Cook's petrels are so numerous that the losses due to the cats would be negligible compared with that from other causes; the general conclusion is that the cats are unlikely to be seriously affecting the bird populations. On the other hand their predation on the rats is of little value in protecting the birds as has sometimes been suggested, but were it not for the rats which are particularly numerous in late autumn predation on the small birds would be much more severe.

The hedgehog is of some importance to the gardener, farmer, and sportsman as destroyer of animal pests, a carrier of the disease *Leptospirosis pomona,* and because of its alleged partiality to game birds' eggs. Investigations carried out by an officer of the Animal Ecology Section showed that in suburban areas slugs and millipedes are the chief items of diet though some snails are also eaten; on grasslands, slugs and moth caterpillars; and on sand dunes, snails, millipedes, and frogs are the main foods. In addition, beetles and spiders are frequently eaten but do not contribute much to the bulk of food. Other items, such as earthworms, cicada nymphs, and small leaves or clover buds may be taken in numbers or quantity during certain seasons. No evidence was found of hedgehog predation on ground nesting birds in the areas studied, and it is concluded that even if isolated cases of predation may occur, their effect on bird populations is negligible.

MANOOL

Some 25 years ago in the course of research investigations into the resin extractives of New Zealand native trees, a compound named manool was isolated in the Dominion Laboratory. The chemical structure of this substance was established and it was shown to be a diterpene alcohol somewhat similar in composition to a known compound, sclareol, which was present in the sage *Salvia sclarea.* Interest was reawakened in manool and sclareol when it was shown in 1949 that ambrein, the essential fraction of ambergris, had a similar chemical structure and that the characteristic odour of ambergris was the result of the oxidation of ambreinolid derived from ambrein. Swiss workers prepared ambreinolid from manool and sclareol, and a potential market therefore existed for these substances to replace ambergris. At that time, 1952, it was thought that the supplies of the particular native trees from which manool could be isolated, *Dacrydium biforme* and *D. bidwillii,* were insufficient to guarantee a constant supply of manool and overseas interest waned in this material.

Following a request from the United States of America in 1957, the whole question of manool was reopened, and as a direct result of experimental work by this Department and the Forest Service it is expected that pilot-scale production of manool will be commenced by a private firm this year in New Zealand. Forest surveys have shown that in the Westland area sufficient *Dacrydium biforme* is present to satisfy a market demand of up to 20 tons of manool a year for 25 years, and a price of £10 a pound has been mentioned for this material. It has been shown that this species contains at least 6 per cent of manool on a dry-wood basis, and pilot-scale studies in the Dominion Laboratory have established the fact that this amount of resin can be extracted at an economic price. There is no record that manool has been found in this proportion in any tree outside New Zealand. Its market competitor, sclareol, occurs in much lower yield. Some 30 pounds of manool have already been supplied to the overseas associates of the interested New Zealand firm and it is understood that this material is acceptable to the perfume industry. A future development could be the food flavouring industry in the United States of America, and the scale of commercial operation in New Zealand will depend upon the demand from this source. With this in mind other trees of the *Dacrydium* genus are being investigated and the possible conversion of the isomeric manoyl oxide, from *Dacrydium colensoi,* to ambreinolid is being studied.

MANUFACTURE OF HYDROCHLORIC ACID BY ION EXCHANGE

The increasing importance of casein in the dairy industry has provided an incentive for the improvement of manufacturing methods. Precipitation of casein by dilute hydrochloric acid has been investigated by the Dairy Research Institute as an alternative to the customary lactic acid process; firstly, because there is a favourable market overseas for muriatic casein; and secondly, because the use of hydrochloric acid might enable a continuous process to be developed which would require simpler plant and allow more exact control than conventional batch methods. The present cost of imported hydrochloric acid is too high to permit economic production of muriatic casein, and the Dominion Laboratory was asked to examine the possibility of manufacturing the acid in New Zealand. Production by orthodox methods was shown to be quite uneconomic. A novel approach was therefore tried in which

sodum chloride is converted to hydrogen chloride by means of a suitable ion exchange resin. In practice, a brine solution would be passed through a bed of the resin, giving an effluent of dilute hydrochloric acid. When the resin is exhausted it could be regenerated with sulphuric acid, which is comparatively cheap.

A thorough investigation of the process was carried out on a laboratory and pilot-plant scale, to provide the data needed for design purposes. From the results, the most favourable operating conditions have been established. General recommendations were drawn up for the design and control of a plant which would meet the acid requirements of a single dairy factory and could be readily operated by factory labour.

The investigation showed that the total production costs of hydrochloric acid in such a plant would be approximately half the cost of imported acid. As a result of these findings, the Dairy Research Institute can proceed with factory testing of muriatic casein manufacture, knowing that acid costs will not be a deterrent to the success of the process.

GEOTHERMAL INVESTIGATIONS

In 1952 when the geothermal power project was in its early stages, it was realised that this underground steam was considerably contaminated, and might be more corrosive to power-plant equipment than normal boiler steam. In this respect the Wairakei steam had to be regarded as unique, since practically no quantitative corrosion data for similar steam was available from the literature, or from the Larderello geothermal steam plant in Italy. Investigations were therefore begun in Dominion Laboratory to ensure that the projected power turbines and steam handling equipment could be kept free from undue corrosion. Tests in the laboratory and in the field have shown that:

(1) Because of its impurities, the geothermal steam is more corrosive than clean boiler-plant steam. However, with the exception of some copper and nickel alloys, the rates of surface corrosion of the common engineering alloys are low enough to permit their economic use in plant handling geothermal steam, provided leakage of air into the steam is avoided. If air is allowed to mix with the steam the corrosion rates of these alloys are drastically increased, to the extent that they could not be used unprotected in these conditions. A few alloys such as austenitic stainless steel, aluminium, and titanium are highly resistant to corrosion in aerated steam, austenitic stainless steel and titanium in particular being practically immune to surface corrosion under all steam conditions.

These investigations have defined the requirements for selection of materials in plant design and of plant operating precautions which will be needed to avoid excessive surface corrosion damage.

(2) Investigation of the conjoint actions of stress and corrosion in geothermal steam has shown that several important turbine alloys are susceptible to spontaneous fracture when placed simultaneously under tensile stress and exposure to geothermal fluids. When exposed without stress or when stressed and exposed to clean steam, these alloys do not fracture spontaneously. This phenomenon, usually known as stress-corrosion cracking, can be very dangerous if it occurs in plant operating at high levels of stress.

Extensive investigations, correlated with the results of overseas research and plant experience, have defined the conditions under which stress-corrosion fracture of the important engineering alloys is likely to occur in geothermal steam plant, and which must therefore be avoided in plant design.

(3) Owing to the presence of hydrogen sulphide and the absence of uncombined oxygen, corrosion of steels by air-free geothermal fluids produces hydrogen, part of which can diffuse into the steel. If present in sufficient quantity, this diffused hydrogen is known to be capable of causing serious blistering and embrittlement of the metal. Quantitative studies have shown that the amounts of hydrogen diffusing into mild steels exposed to geothermal steam are insufficient to cause detectable embrittlement or blistering, unless the steels are particularly "dirty". In this respect geothermal media are considered rather innocuous, and the occurrence of blistering can be regarded as symptomatic of poor steel quality rather than of severity of the steam environment. Several simple surface protective treatments for steel have been shown highly effective in reducing the quantity of hydrogen diffusing into steel exposed to geothermal steam.

(4) Other investigations have shown that the combined erosion and corrosion effects of water droplets travelling at high velocity in geothermal steam and impinging on metal surfaces, as in steam turbines, are not likely to be unduly severe.

These investigations are being continued. All results are being passed to the consultant engineers to aid in power-station design.

At the beginning of the year the geothermal section at Wairakei was transferred from the Dominion Physical Laboratory to the Geophysics Division. This section has in the past played a major part in developing temperature measuring and steam metering equipment now in constant use by the Ministry of Works. During the past year, this section has evaluated the heat escaping naturally and mapped the boundary of the Wairakei geothermal area. Because there is no evidence so far that the exploitation by drilling has increased the flow of heat into this area, the natural heat escape gives a reasonable estimate of the electric power potential assuming infinite life. This estimate can be increased by drawing upon the large quantity of heat stored in the rocks tapped by the drillholes, but the life of the power station is thereby reduced. Estimates of the useful life for power generation purposes at different rates of production have been made.

Studies of the pressure and temperature distribution in the drillholes at Wairakei suggest that most of the hot springs and drillholes are fed by hot water percolating up to two miles from a source further west. Chemical and petrological evidence supports this conclusion which confirms deductions made from the early magnetic prospecting. Since the western sector may thus provide a greater percentage of high-pressure steam than is now available, the locations of test bores have been discussed with Ministry of Works engineers.

Reconnaissance surveys at Waiotapu have shown a rather similar agreement in the conclusion drawn from various scientific approaches. Recommendations based on this work have led to the recording of the highest temperatures and pressures so far encountered in New Zealand geothermal drilling. However, conditions at Waiotapu differ from those

at Wairakei in several important respects. The most important differences are the tendency for rapid mineral deposition to take place and the existence of several aquifers superimposed one above the other.

Surveys have also been made at Orakei-Korako, Helensville, Te Aroha, Kawerau, White Island, and other geothermal areas. During the year, a paper has been published concerning the geophysical investigations made at Kawerau prior to the selection of this site for the Tasman Pulp and Paper Company's mills where the natural steam is now being used commercially.

Theoretical studies and laboratory experiments are in progress to clarify the mechanics of fluid convection in permeable rocks and of the flow of steam-water mixtures from the rocks into a drillhole. These investigations and a study of the regional heat flow in the centre of the North Island will assist in a better understanding of the mechanisms of heat flow which are related to the utilisation of natural steam for electric power generation.

ANTARCTIC IGY ACTIVITIES

During the past year a considerable proportion of the Geophysics Division's activities have been diverted to the IGY programme covering stations in New Zealand, the Pacific Islands, and the Ross Dependency. However, it is pleasing to be able to report that when the IGY concluded on 31 December 1958 the observational programme had almost been completely achieved as planned.

The 1958 teams, at Scott Base under the leadership of L. H. Martin (New Zealand Broadcasting Service) and at Hallett Station under K. J. Salmon (Air Department), had an extremely successful year in all the scientific discipline. Although the results are only at the preliminary analysis stage, several interesting papers have already been published. Among these may be mentioned:

(1) An account of the recording of radio noises called "whistlers" at Scott Base. It was not expected that these would be recorded at such a high magnetic latitude and their unexpected occurrence has considerable significance on radio and geomagnetic theory.

(2) A demonstration that eastern Antarctica has a continental type of crustal structure whereas western Antarctica has an intermediate type similar to New Zealand. This information was obtained by analysis of earthquake waves which travelled round the surface of the earth and were recorded on the seismographs at Scott Base, Hallett Station, and Mirny.

(3) Observation on the auroral spectrograph films of the presence of lithium in the atmosphere over Cape Hallett during August and September of last year. This lithium is believed to have been a product of the high altitude nuclear explosions at Johnston Island, effects of which have been noted at New Zealand stations at Apia and Rarotonga. Hallett Station is 5,500 miles from the scene of the explosion.

Relations with other nations engaged in scientific work in Antarctica has been maintained at a high level. Scientific information was freely exchanged with other Antarctica stations by radio and during the visits made to Scott Base by numerous American scientists, French and Russian members of the Weather Central at Little America, and also the Russian scientists from Mirny who flew to McMurdo Sound via the South Pole.

The Russians were so impressed by the scientific work being carried out at Scott Base that Paul Ostapenka, on his return to Moscow, stated that "the activities of the New Zealand scientists may serve as a good example of the efficient use of people and material resources. Our colleagues from New Zealand have succeeded in accomplishing a comparatively extensive programme at their small stations".

JOHNSTON ISLAND NUCLEAR EXPLOSIONS

On the night of 1 August 1958 the United States Atomic Energy Commission exploded a large nuclear missile in the upper atmosphere at a height of more than 40 miles over Johnston Island in the Central Pacific Ocean.

At the time of the blast the inhabitants of Hawaii, the Cook Islands, Western Samoa, and the islands of the Fiji group reported the occurrence of phenomena in the sky similar to a display of the aurora australis. Such displays in the tropics are always of the greatest interest to geophysicists because of their exceeding rarity and because when seen in such low latitudes they have always occurred in association with unusually severe world-wide magnetic and ionospheric storms. Until August 1958 only one aurora australis had been visible from Samoa since the establishment of the observatory there in 1905.

In Samoa this visual display lasted for about 15 minutes and unusual changes were also recorded on the magnetograms there. In general, magnetic disturbance from natural causes is more intense at Amberley than at Apia. On comparison, it was found that the effects recorded at Apia coincident with the Johnston Island explosion were not discernible on the Amberley magnetic record. The abnormal direction in which the sky phenomenon was seen, coupled with the abnormal magnetic effects recorded at Apia showed that the display seen was not a natural auroral manifestation. A report was published in *Nature* on 15 November 1958 explaining that the manifestation seen was an artificial aurora due to the nuclear explosion over Johnston Island which is over 2,000 miles to the north of Samoa.

Abnormal radio communication conditions were also reported. A radio fade-out occurred at the time of illumination of the sky, phenomenally high frequency reflections took place for some time afterwards and excessive absorption of medium frequency signals occurred throughout the Pacific area for about a week after the explosion.

At Rarotonga on 1 August a unique form of ionospheric storm was observed. Initially a very high electron density in the F2 layer of the ionosphere was recorded, the actual value of which lay beyond the range of the recorder and was probably the highest ionization density ever recorded. The records were consistent with an intense and complex shock wave travelling from the seat of the explosion. There are indications also from the Godley Head ionograms that this shock wave travelled as far south as Christchurch.

As Radio America had issued a warning it was possible to observe more closely at Apia and Rarotonga the effects due to the explosion of a second nuclear bomb over Johnston Island at a height of about 20 miles on 12 August. In spite of poor weather conditions in Samoa visual observations were made and photographs obtained. This artificial aurora lasted about 15 minutes and the Apia magnetic records again showed abnormal effects when compared with the Amberley

magnetic records which were calm, showing that no world-wide magnetic storm was in progress. The character of the Rarotonga ionogram was not the same as that for the event on 1 August 1958. The F2 layer phenomenon which followed the blast was much less dramatic but medium frequency radio absorption was even more pronounced than that from the earlier event. Low frequencies were still being completely absorbed and the ultra high frequencies were covering phenomenal ranges even a week after the high altitude test.

The chain of scientific events apparently associated with the nuclear blast was similar – but not in the same sequence – to the effects produced in the earth's atmosphere by radiation from the sun at times of excessive solar disturbances. New Zealand, with its magnetic observatories at Apia (Western Samoa) and Amberley (New Zealand) and the ionospheric observatories extending from Rarotonga (Cook Islands) through Godley Head (New Zealand) to the Antarctic is uniquely situated to make an intensive study of the phenomena reported above. Data obtained at other observatories in the Pacific area are still being collected and the study of the ionospheric and magnetic effects of the explosions is being continued. It is hoped that these will throw considerable light on the theory of magnetic storms and aurorae and the associated ionospheric disturbances, resulting in a clearer picture of upper atmospheric physics.

ROSS SEA OCEANOGRAPHIC SURVEY

Since the Ross Sea was first penetrated there has been a steady increase in the amount of our information on its temperature and salinity, its currents, animal life, and the sediments which cover its floor. These investigations have been made partly as incidentals to expeditions with other main purposes; a lesser amount of work has been carried out by purely oceanographic vessels such as *Discovery II*. Much of the available information was derived from the McMurdo Sound and eastern coastal area or along the edge of the Ross Ice Shelf, but did not cover the main open-water area. During this last season New Zealand Oceanographic Institute staff have carried out a systematic survey of the water properties, the animal life afloat and on the bottom, and the sediments. The stations at which samples were taken are distributed more or less evenly over the Ross Sea from the east coast and the ice shelf to the 1,500 fathom line.

The results are enabling a regional picture to be built up of the distribution of animals, sediments and water properties over 120,000 square miles of the Ross Dependency. There is great abundance of the lower forms of marine animals in the shallower waters of Antarctica as photographs of the bottom taken with an underwater camera reveal. The abundance of minute and lowly organisms (even at -2°C) supports the larger and better-known Antarctica animals, the penguins, skuas, seals, and the killer and other whales. The importance of the present study is that a general regional picture of fundamental significance is being established.

STUDY OF THE AURORA

During the International Geophysical Year a fairly extensive programme was undertaken on the study of the southern aurora. The work for this programme was carried out at a number of stations, including several observatories run by other countries, who had agreed to operate

equipment supplied by us. However, the principal centres of activity were the special auroral station set up at Invercargill and the two Antarctic stations – Scott Base and Hallett Station. This programme, although of our own design, was intended to fit in as much as possible with the overall international plans for IGY, which called for a concentrated period of observations covering the subject broadly.

From the results obtained during this IGY period it has been decided to continue the study of the aurora, but in doing so to concentrate on a small number of specific experiments. The centre of activity for this work is the Dominion Physical Laboratory auroral station at Invercargill, but observations are also being made at Scott Base and Hallett in the Antarctic, at Campbell Island, and at a station in Central Otago. (These stations form a line running roughly north-south right through the auroral region.) The United States workers in this subject are very interested in our programme and have arranged to take part, making observations at stations south from Scott Base to the Pole and across to the other side of Antarctica.

The station that has been set up in Central Otago, where cloud is far less common than at Invercargill, is an unmanned automatic observatory. It is equipped with "all sky" cameras and spectrographs, and these are set up to make a continuous set of records of the appearance of the aurora and an analysis of the spectrum of the auroral glow. This station is also providing a continuous record of the cloud cover over the surrounding hills in order to assess the value of that region for a hill-top observatory of a more permanent nature.

During the IGY period a radio propagation experiment was set up to explore the effects on high-frequency signals passing through the auroral zone. A transmitter was set up at Scott Base and a number of receivers were operated at widely separated stations close to or outside the auroral zone. This work is continuing but the intention is to relocate the receivers at the stations on the north-south line from Scott Base up through New Zealand. This plan of a long line of stations fits in with the present-day ideas that the aurora must be regarded as something occurring over a region extending a great distance north and south, rather than a narrow belt. All these stations are equipped with automatic "all-sky" cameras to record the forms of the aurora glow. Some of these cameras are using colour film. Several stations have spectrographs for recording the spectral lines in the glow, information from which shows the presence of various materials in the upper atmosphere gases. At Invercargill there is a radar equipment which can be used to study the location and movements of masses of ionised gases in the upper air, and consideration has been given to the installation of such equipment at Scott Base.

The programme of manual observations has been drastically reduced not only because it is wasteful in manpower, but because it is difficult to make allowance for the human element in the interpretation of the records. The results so far show that the camera is a far more sensitive recorder than man and many more aurora occur than can be seen by eye and, using fast colour film, auroral colours can be recorded that are not visually detectable. It is worthy of mention that the spectroscopic recorders detected the presence of lithium in the auroral glow after the high altitude nuclear explosions in the Pacific. As has been reported

before, the ionised gases that are observed by radar do not coincide with the visual aurora. However, the study of the behaviour of the ionised gases in the auroral region will, it is believed, lead to our finding out a lot more about the whole ionosphere, its formation and circulation. This is of fundamental importance to all long distance radio communication.

ENGINEERING SEISMOLOGY

The analysis of structural response to earthquakes on the assumption that (1) they deflect in shear, (2) they remain elastic, and (3) they have a damping equivalent to viscous damping, is now a workaday affair. Amongst other things, some 20 proposed school buildings in America have been analysed on this basis by the Dominion Physical Laboratory for Mr J. A. Blume, San Francisco, consultant structural engineer.

These assumptions are only partially true for frame structures and completely untrue for bearing or shear wall structures. Frame structures must also yield in severe earthquakes. An analog has been built which will simulate yield in single-storey structure and tests made with six of the severest earthquakes yet recorded. The sort of results obtained indicate that if a structure is designed to yield at a seismic coefficient of 0·3, the permanent set obtained in a severe earthquake is of the order of $\frac{1}{16}$ in. to $\frac{1}{4}$ in. between floor and ceilings. This is a perfectly acceptable sort of figure to the engineer. Further work will have to be done on yield in multi-storey structures, however, before dynamic yield can be taken as the basis for a seismic code.

Attempts are also being made to obtain a dynamic analysis of bearing and shear wall structures. Many buildings of this nature are put up in New Zealand and it is important that their dynamic response to earthquakes should be thoroughly understood, particularly as architectural design is falling so closely into step with functional engineering design that the lessons learned from the performance of the conventional building of 20 years ago in an earthquake are no longer directly applicable. Much of the strength of the older building lay in its architectural features.

VERY LOW FREQUENCY RADIO PROPAGATION RESEARCH

The Dominion Physical Laboratory provides a national standard of radio frequency, and this is broadcast at regular times for various users within the country. In order to maintain this standard to a high order of accuracy it is essential that it can be compared with similar standards overseas. There are a number of overseas standard frequency broadcasts which can be received here, but they are almost all in the high frequency band and, after travelling the great distances to New Zealand via the ionosphere, they are much less stable as received here than we know our own standards to be. Consequently when the very low frequency transmission (16 kc/s) from Rugby was brought up to standard frequency accuracy, an attempt was made to receive the signal over a long period and to compare its stability with our local standards. Because of the low signal strength it was necessary to develop special receiving equipment for this purpose. The results of the observations soon showed that the signals from Rugby as received in New Zealand are very stable and, except for two short well-defined periods each day,

are good enough to provide a good check on our local equipment. Since Rugby is almost antipodal to New Zealand this was a result of some importance and it was decided to embark on a more thorough study of the propagation of these very long waves over great distances. It so happened that there was a world-wide reawakening of interest in these frequencies because of their possible value for long-range navigational aids. The cost of such a high-power very low frequency station is large, but if the signals can be received as reliably and stably round the world as experiment so far seems to indicate, then two such stations could possibly provide a world-wide position-fixing system for navigation as good or better than any of the long-range systems at present developed. The total cost of the V.L.F. system might well be less than the cost of the large number of stations needed at higher frequencies. New Zealand, at the edge of the wide expanse of the Pacific, must always be interested in navigational aids having a very long range.

At the present time observations are being made on a number of other stations working in this frequency band as well as Rugby. An important matter which is included in our programme is the so-called east-west anomaly. Observations have shown that these very long waves travelling in an easterly direction round the world are received in greater strength than if they travelled the same distance in a westerly direction. There is no such anomaly in a north-south direction. A paper has been published putting forward a theoretical explanation of this in terms of the effect of the earth's magnetic field, and a possible method of the actual mechanism of propagation.

In order to test this theory it will be necessary to make a far more thorough examination of the actual process of propagation at these frequencies than has been done so far. Radio research groups in the United States are actively involved in work on this subject. They have expressed considerable interest in our programme and are prepared to collaborate with us.

HOUSE HEATING

"Solar heaters", which collect radiant heat from the sun and sky might be used in many New Zealand homes for water heating and house heating. The radiant heat falling on 200 sq. ft. during an average winter day is equivalent to that of 30 kilowatt hours of electric power and would be sufficient for house heating if it could be collected and used. The problem is to make a system that is reasonably inexpensive and yet can be expected to supplement or replace other forms of house heating on almost all occasions during the year.

Two experimental solar heaters are being built at the Dominion Physical Laboratory. The collector surface is painted galvanised iron which might in many instances be part of the actual roof of the house. It is covered with glass or with translucent plastic to retain the heat and this covering need not be rainproof. Insulating board fixed to the underside of the rafters forms a duct through which a fan draws air past the heated iron. The heated air may be taken directly into the rooms of the house but more commonly it will be necessary to store the heat for later use. The air is therefore blown through a pile of stones below the house, say 5 cubic yards of 2-inch rubble, which abstracts the heat and stores it. For maximum efficiency a temperature-sensitive device must control the air flow to ensure that the air drawn from the collector on

the roof is never at a temperature lower than that attained by the store. Warm fresh air can then be got when needed by reversing the fan to draw air through the rubble and into the house.

Air seems more suitable than water as a circulating medium when the main purpose is to heat the rooms of a house. Air is more cheaply piped and driven, and air leaks are less destructive than leaks in a water system. It is unlikely, however, that the full requirements of domestic hot water could be met by the present method. Some economy in electric water-heating would be got by feeding the cistern with warm water from a reservoir enclosed in the rubble. Systems that aim only at supplying hot water use water as a circulating medium and are already being developed commercially.

The usefulness of a solar heater depends on many factors, the weather, the area and aspect of the collector on the roof, the capacity of the heat store, and the extent to which the system may be made self-regulating. Efficiency has to be balanced against cost. No one model will suit all localities, all types of house and all pockets. An electro-mechanical analogue machine is being built which should allow the optimum sizes of collector and store to be estimated rapidly in any particular instance. The experimental models will check the estimates made in this way and it is hoped that the economics of this form of domestic heating will soon be much better understood.

TRITIUM AGE MEASUREMENTS

We are pleased to report that results are now being obtained by the Division of Nuclear Sciences using the tritium technique reported in the 1956–57 annual report.

Radioactive hydrogen (tritium) has a half-life of 12·25 years and is produced by cosmic rays mainly in the stratosphere. It burns to water and then enters the earth's meteorological and hydrological systems. Thermonuclear tests have also released large quantities of tritium into the atmosphere. (The few tests so far made have produced as much tritium as would be produced in 20 years by cosmic rays.) Pre-bomb levels of tritium were: ocean water 0·5, ocean rains 1, and continental rains 5 tritium units (1 tritium unit per million, million, million units of hydrogen). These measurements were made in the Northern Hemisphere before 1953. It will not be possible now to make any measurements on cosmic ray produced tritium alone in New Zealand but the excess tritium, placed in the Northern Hemisphere will enable exchange times between stratosphere and troposphere and between each hemisphere to be determined. There can be no better way of distributing tritium on a global scale in the atmosphere than by hydrogen bomb explosions.

Tritium is counted as a gas in a low background geiger counter. As the limit to the gas counting is about one part of tritium to 10^{15} parts of hydrogen, it is necessary to enrich the sample by a factor of 1000. This is done by a multiple-stage process of electrolysis in which 15,000 ml of water is reduced to 4 ml. The tritium isotopic enrichment obtained can be estimated from the deuterium enrichment measured on our mass spectrometer. A unique method of calibrating the mass spectrometer for measurements of the D/H ratio in the range we are interested in (1–20 per cent) has been developed. For counting the

tritium, 1 ml of the enriched triated water is converted to hydrogen by passing over heated zinc and the hydrogen absorbed on activated charcoal at liquid nitrogen temperature (— 192°c). The hydrogen is then evolved into a 300 c.c. counter that in our low background counting shield has a background of 6·5 c.p.m. In water uncontaminated by H-bomb-produced tritium we would expect 1–2 tritium units that would give an additional 2–3 c.p.m. on our counter.

Tritium measurements are now being made for ground water studies particularly in the geothermal areas. It should be possible for us to use this tracer to calculate the time for ground water to sink to depths at Wairakei and to be heated. These measurements will be very valuable in estimating the size of the hot water reservoir, the method of transfer of magmatic heat to the water, the life of the field, and in siting new bores.

RADIOACTIVE FALL-OUT

Rainwater continues to be received monthly from six fall-out stations in New Zealand and at longer intervals from Campbell Island and Fiji. The results are sent at two-monthly intervals to the four World Data Centres – Moscow, Stockholm, Tokyo, and the United States. The main points of interest which have arisen are: monthly activities are highest in high rainfall areas; the late 1957 test series in Australia appears to have caused increases of short-lived activity at the Auckland and Havelock North stations; no increases in New Zealand fall-out can be definitely attributed to Pacific Island tests, supporting our statement last year that fall-out over New Zealand is stratospheric fall-out from H-bomb tests; in the last two years springtime increases in specific activity of rainfall have been noted. This confirms British observations of ^{90}Strontium in rain which they have correlated with a springtime stratosphere-troposphere leak in mid-temperate latitudes. This leak is one feature of a proposed global air circulation model. We should get some interesting data on the Southern Hemisphere latitude variation of such a leak when our ^{90}Strontium measurements are completed.

The low background beta counter and the gamma scintillation spectrometer supplied by the United States Atomic Energy Commission have been installed and measurements can now be made of the ^{90}Strontium, ^{140}Barium and ^{137}Caesium in every rainfall at Gracefield in an endeavour to calculate the storage times of radioactive debris in the stratosphere.

RADIOCARBON DATING

During the year 79 samples have been dated for other laboratories. Of these 19 were for overseas laboratories, 69 for the New Zealand Geological Survey, and 16 for the New Zealand Oceanographic Institute. The demand from overseas is such that, with our New Zealand commitment for this equipment, overseas customers have to wait two years for results. A rough estimate shows some 148 samples waiting for the Geological Survey and a further 27 for the Oceanographic Institute. These two divisions of the D.S.I.R. alone have a yearly demand for ^{14}C ages of 270 samples, foreseeable for at least the next five years. With our existing equipment it is impossible to make any serious attempt to satisfy this demand unless our experimental equipment is duplicated and additional staff trained.

Some 60 samples have been analysed for ^{14}C content in connection with this Division's study of the carbon cycle in nature. Measurements of the ^{14}C activity of the carbon dioxide of the atmosphere over New Zealand have been continued. Samples have also been collected from Fiji and Melbourne. No difference in ^{14}C activity is apparent between these three stations. The increase of ^{14}C in the Southern Hemisphere due to atomic weapons is now 12 per cent above the 1954 value. From the shape of the curve of atmospheric ^{14}C versus time it can be shown that the bulk of the atomic weapons ^{14}C is held in the stratosphere, from which it leaks slowly back into the lower atmosphere. Seawater samples are also being measured at regular intervals so as to improve the accuracy of the experimental determinations of the rate of exchange of carbon dioxide between the atmosphere and the sea.

The possibilities of radiocarbon as a tracer for studying the movements of water and gas underground in the thermal areas have been investigated and the interdependence of the various factors affecting the ^{14}C content of carbon dioxide coming to the surface with water and steam has been evaluated. It has been shown that in the Wairakei area the time for water to travel from the surface to depths of 1,500 ft or more is less, and probably considerably less, than 40,000 years. When the tritium method for dating water, which is now in operation, furnishes actual ages for these thermal waters the ^{14}C data will allow precise determinations of the history and movements of the carbon dioxide gas.

DEEP OCEAN CURRENTS

Oceanographers have come up with a new point of view in recent years: they are talking of the "age" of various samples of sea water taken at depths well below the surface. The property of sea water they are measuring is the carbon 14 activity. A reduction in this below normal indicating that the sea water has been shielded from cosmic rays which otherwise would have kept the ^{14}C activity up. Water that has an "age" is thus not taking part in the turnover and mixing that goes on in the top 600 ft of the surface waters of the ocean. The N.Z. Oceanographic Institute and Division of Nuclear Sciences have been collecting large (80 gallon) samples of seawater both from the surface and from depths down to 1,500 fathoms and measuring the activity. This gives a new method of sorting out the way different layers of the ocean are moving. Samples have been obtained from 10°s to 78°s and the "age" figures (up to 2,500 years) obtained; the fresh ideas on ocean circulation that are coming from them are a significant contribution to a world-wide problem. Not only is the matter one of fundamentals but of immediate and pressing application. The ocean deeps have previously been looked at favourably as a suitable site for dumping nuclear wastes. The possibility and safety of this operation demands a clear idea of the rate at which the bottom waters of the ocean are moving and of the time taken for the whole circulation system to turn over and lift bottom waters to the surface.

ROYAL NEW ZEALAND NAVAL ASSISTANCE

The New Zealand Naval Board has always appreciated the value of oceanographic research and has assisted the Department in many ways. Without such assistance it would have virtually been impossible for the Department to increase its knowledge of the biology, geology, and

hydrology of the south-west Pacific Ocean and New Zealand coastal waters. Oceanographic work carried out in conjunction with the survey of New Zealand coastal waters by HMNZS *Lachlan* and similar work carried out in New Zealand waters by other ships of the RNZN have materially increased our knowledge.

During the past three years the Naval Board has made the research ship *Tui* available for two to four months annually; has assisted with oceanographic work on board *Endeavour*, *Pukaki* and *Hawea* en route to Scott Base and in the Ross Sea; assisted with the unloading, transport of supplies, and repair of Scott Base buildings; has assisted in crustal structure projects in New Zealand; and has given assistance on other occasions.

The assistance and interest shown by the Naval Board in scientific investigations is very much appreciated.

THE ENGINEERING GEOLOGY OF HYDRO-DAM SITES

One of the New Zealand Geological Survey's most important services is the application of geology to the problems encountered in the planning and construction of major civil engineering works such as dams, bridges, roads, tunnels, and the foundations of large buildings.

For many years now the Geological Survey has played an active and important role with Ministry of Works in the investigation and construction of New Zealand's large hydro-electric dams. Many and varied problems of engineering geology have been posed by these projects and their solution has called for contributions from all sections of the Survey, often in cooperation with other D.S.I.R. units, especially the Geophysics Division. Survey geologists have made important contributions to site investigations and planning of the North Island hydro-electric stations – Karapiro, Maraetai, Atiamuri, and Whakamaru – and of Roxburgh and Lake Hawea in the South Island. Geologists are at present working on a number of schemes still in the planning stage: in the past two years they have carried out geological studies for the Rangitaiki, Kaituna, Whakatane, and Motu schemes in the Bay of Plenty area, for the upper Wanganui-Tongariro River scheme in the central North Island, and for the Benmore scheme in Otago.

A dam is only as strong as the foundation rocks it stands on: Ministry of Works engineers therefore need from the geologists a detailed geological map of the site and its surroundings, showing the type of rocks present and their structural arrangement, and also the presence of any faults, crush zones, rock-joints, or other features that might cause weakness. They need a report also on whether the rocks are fresh or decayed, and how deeply buried by superficial gravels; whether strong enough to take the great weight of the dam without crushing or shearing; and, very importantly, whether the dammed-up water can leak under the dam or around it through the rocks. The possible presence of active faults nearby needs thorough investigation too. The following examples illustrate the sorts of dam-site problems recently investigated.

For the Kaituna scheme it is proposed to dam the Kaituna River at its outlet from Lake Rotoiti near Rotorua, and to send the lake water instead by a long tunnel to a proposed powerhouse about $4\frac{3}{4}$ miles down the river. The rocks of this region consist of thick sheets of ignimbrite volcanic rock buried (except in the valleys) by pumice and volcanic ash. Survey geologists have reported on the rocks at the proposed outlet

dam site and pointed out the probable need for extensive cement grouting to seal the numerous fractures in the ignimbrite which would be the dam foundation rock at that point. There are two or three possible sites for the first powerhouse down the river, and a report has been made on the good and bad features of each of them. Geological information has been supplied too, about the sorts of rocks likely to be encountered in drilling the long tunnel from the lake.

Three possible dam sites have been suggested on the lower Whakatane River, and Survey geologists recently made a trip in a dinghy down the river and made a preliminary report on the rocks at each site, pointing out the presence of a major fault – the Whakatane Fault – in the area, which has not moved in historical time but which is not certainly inactive.

The Rangitaiki River scheme is a plan to construct an earth dam in the gorge of this river at one of several possible sites between Rangitaiki and Te Teko. The main geological engineering problems are concerned with the location of the exact position of a major fault (inactive probably for several thousand years) known to be present in the vicinity of the proposed powerhouse site and with the finding of a supply of suitable rock materials with which to build the dam.

The Benmore earth dam, on the Waitaki River in Otago, will use up to 5,000,000 yd of earth and rock. Survey geologists have had the task of finding, within a few miles of the dam site, a source for this huge quantity of material. The requirements are for material with a high content of clay or silt which, when compacted, will form an impermeable core for the dam. There were several possibilities – weathered river gravels, Tertiary clays and fine sands, the crushed rock of fault zones, and also the clay soil and rotten rock forming the upper weathered parts of the old greywacke and argillite rocks that make up the hills and mountains of the Benmore area. The geologists have recommended the latter source as the most preferable and have suggested a place where the depth of weathering of the rocks is likely to be adequate to supply the quantity of material needed.

The other important problems the geologists have considered at Benmore have been the position of crush zones and other planes of weakness in the greywacke and argillite rocks around the dam site, and the tracing of certain faults in the Benmore district known from geological evidence to have been active in geologically recent times.

The answers to these engineering geology problems are achieved by detailed work in the immediate vicinity of the construction, but are based on a knowledge of the regional geology of the district. Regional geological knowledge is the product of systematic geological mapping, the basis of all applied geology; without systematic geology many engineering geology problems can only be partly, if at all, answered. If this geological capital – the regional mapping – is not continually revised and extended, the ability of the Geological Survey to act as national consultants on all geological matters rapidly declines.

GRIT EMISSION FROM CHIMNEYS

As part of work at the Auckland Industrial Development Laboratories on the reduction of air pollution from the combustion of fuel, it has been necessary to determine the grit load that is emitted from industrial smoke stacks. Most stacks emit large volumes of hot gas, some acids in

vapour form, a fair quantity of water vapour, and a certain amount of grit and dust, the particles ranging in size from over 0·1 in. (2,500 microns) down to less than 1 micron.

We have been mainly concerned with the grit and dust particles above 10 microns in size, as these are the particles which may fall to the ground within reasonable distance of the smoke stack, and which will cause trouble if they land on the products being processed, such as meat, paper, etc., as well as creating a nuisance in the immediate neighbourhood of the plant.

To overcome this grit nuisance arrestors may be installed and in their design it is necessary to know beforehand just what they will have to do and what is the amount, size, and nature of the grit that they will have to handle. To do this grit sampling in a straight length of the stack of flue is carried out, either by extracting a sample of the flue gas through a heated tube and filtering out the grit sample, or by collecting the sample in the stack itself by means of miniature cyclone separators.

In addition to the small sample of grit thus obtained it is necessary to measure gas velocities, temperatures, and pressures, and to survey the cross-section of the stack in as many as 24 points so that representative figures may be obtained.

Some examples of combined wood waste and coal firing have also been studied, with the object of finding whether collection and refiring of the charcoal grit would be economic.

STRAIN GAUGING AND DYNAMIC BALANCING

In the past year electrical resistance strain gauges have been applied to a variety of problems. A weighing system has been installed on a plaster hopper to indicate and record the weight of the contents continuously. This assists in quality control of the finished product.

Ten special load cells have been made and used for accurately levelling a large autoclave and ensuring even loading of the supports.

The stress conditions in a girder supporting one of the Auckland Harbour Board's new cranes has been determined by strain gauging. The Auckland Industrial Development Laboratories are at present co-operating with the Soil Mechanics Bureau and engineers of the Auckland Harbour Board in an investigation on soil pressures at the Freyberg Wharf, at present under construction. Our part of this project is to determine the stresses at a number of points in the sheet piling, which involves mounting strain gauges and protecting them from the effects of water pressure and severe mechanical shock during dumping of the rock filling.

A 500 h.p. motor has been dynamically balanced after rewinding while the balance of a 250 h.p. motor was investigated in an effort to discover the cause of undue bearing wear. Several smaller balancing jobs were carried out on brush rolls used in insulating board manufacture.

PROBLEM IN AIRLINE RESERVATIONS

Airlines all over the world are faced with the problem of high cancellation rates and consequent loss of revenue through planes leaving with empty seats. The Applied Mathematics Laboratory has recently collaborated with an airline to try to overcome this problem by allowing overbookings to be made and relying on subsequent cancellations to keep the number of bookings left at departure time at, or just below, the seating accommodation of the plane.

An examination of booking records over a three-month period showed that the cancellation rate was 40 per cent; in other words nearly half the bookings were subsequently cancelled. Statistical analysis showed that first-class passengers are more likely to cancel than tourist class and that cancellations could effectively be regarded as random events, which was to be expected since most passengers are independent of each other.

The form in which records were kept made it possible to follow up groups of passengers whose bookings were confirmed at various given times before departure and to determine the cancellation rate for each group. From this information the statisticians determined a probability law for each category from which they predicted, with a given degree of confidence, that there would be at least a specified number of cancellations. This knowledge enables the airline to accept extra bookings without any likelihood of having to turn passengers away, since the cancellations can be relied on to bring the final number of passengers down to the capacity of the aircraft. At the same time the revenue lost due to last-minute cancellations can be greatly reduced. The value of this type of operational research is that it increases the effective resources of the country by better utilisation without any extra capital cost.

SPONTANEOUS IGNITION IN WOOL BALES

Experience has shown that large volumes of combustible material are prone to ignite spontaneously. It has been found dangerous to allow oily waste rag to accumulate in large disposal bins. The coal which is mined for the new power station at Meremere is stored under water to avoid spontaneous combustion. Bales of greasy wool are a fire hazard and the cause of many outbreaks of fire on board ships taking our wool overseas. It was this last problem in which the Applied Mathematics Laboratory became involved through its collaboration with the Dominion Laboratory.

Adequate safety measures, often the fruits of costly experience and disaster, have been incorporated in the handling practice of these materials, but a full and adequate physical explanation of the phenomenon itself has only recently emerged. Only through a full understanding of the fundamental mechanism of self ignition is it possible to devise foolproof working rules which are not unnecessarily restrictive or costly.

It appears that most of these materials are poor conductors of heat, are permeable to air, and oxidise or contain oxidisable material which reacts with the air, albeit ever so slowly at room temperatures, with an evolution of heat. This liberated heat is either stored in the medium, providing the energy to raise its temperature, or is conducted to the cooler surfaces. In general a rise in temperature of 10°C doubles the rate of chemical reaction and with it the quantity of heat evolved in a given volume. The additional heat evolved tends to raise the temperature and this situation would inevitably give rise to an explosive temperature increase were it not for the fact that at the same time the temperature difference between the centre and the surface of the medium is also increasing and thus draining the heat more rapidly. In any given situation the chain of circumstances will either culminate in a steady state regime with a stable fixed temperature distribution throughout the matter and a maintained balance between the energy liberated in the oxidation reaction and that conducted to the boundary, or the material will burst into flames.

This theory can be expressed in a quantitative manner in terms of the conductivity and heat capacity of the material and the experimentally measured energy liberated by the chemical reaction. This is done by drawing up a balance sheet for each arbitrary volume of medium which equates the energy liberated per second to that conducted over the boundary of the volume. In this way it is found that the possible steady state temperature regimes conform to a geometrical law. In any given situation a study of the set of all steady state temperature distributions shows that for a given air temperature there is a critical size for a volume of the material; a greater volume must inevitably ignite.

The value of obtaining a general solution to a problem of this type which arose out of a study of wool bales, is seen by the fact that it shows that essentially similar problems of stability are involved in such diverse fields as nuclear reactors, which will be of practical interest to New Zealand in the future, and in the burning of coke fires.

INDUSTRIAL UTILISATION OF FATS

The synthesis of plastic coatings from fats by the formation of acetoglycerides has been achieved and the preparations are comparable with those produced overseas. Their possible use as a coating for cheese and other foodstuffs is awaiting further testing.

Work on tall oil, a by-product of wood-pulp industry, is proceeding and more information has been obtained about its composition which should assist in the eventual utilisation of this product.

Considerable progress has been made by the Fats Research Laboratory in the manufacture of detergents from tallow. The project has considerable interest in industry at the present time because of the restriction on the imports of detergents.

PASTURE LIPIDS AND THE LIPIDS OF ASSOCIATED MICRO-ORGANISMS

As part of the major project on bloat carried out by the Plant Chemistry Division at Palmerston North, the Fats Research Laboratory has been investigating the lipids of red clover chloroplasts which are thought to play a role in the occurrence of this disorder. As mentioned in last year's report, the major constituent fatty acid is linolenic acid. It is now shown that in addition undecanoic acid occurs. This acid has not been reported previously in plant lipids and its occurrence has considerable interest because of its fungicidal properties. It has been found that the acetone soluble fraction of pasture lipids does not, as previously supposed, consist simply of triglycerides but is composed of fatty acids combined with considerable amounts (30 per cent) of carbohydrates in addition to (5 per cent) glycerol.

Work is also being carried out on the lipid composition of the fungus *Sporidesmium bakeri*. The lipids of another micro-organism *Rhodotorula graminis* di Menna also isolated by the Soil Bureau from grass has been examined. It has been found to have a fatty acid composition similar to that reported for other yeasts.

WHEAT RESEARCH INSTITUTE

What may prove to have been a major step forward for the milling industry was taken during the 1959 wheat harvest when merchants were able to give millers an indication of the bread-baking quality of most of the wheat lines they had to offer. This enabled merchants to sell lines suitable for bread making to flour millers and to offer other lines for uses in which bread-baking quality had no significance.

The return to wheat growing has brought into relief the need for millers to know the milling and baking qualities of the wheat lines available to them. The local wheat is no longer swamped by a larger proportion of imported wheat. The Wheat Research Institute accordingly turned its attention to the evaluation of rapid testing methods that might be so much faster than baking tests that they could be used for a far larger number of samples and without seriously delaying the movement of the wheat from farm to mill. It was not until December, however, that the institute concluded that one method – the Zeleny test – was worth a full-scale trial in a testing service. There was a particular reason for such a scheme in the 1959 harvest. Arawa wheat – a high-yielding variety lower in baking quality than the standard variety Cross 7 – had spread much faster than the Wheat Research Committee had expected when it authorised the Crop Research Division to release the wheat. Arawa had been intended for the Dreadnought area only and the committee expected that the later release of Aotea, better in yield and baking quality than Arawa, would be in good time to occupy the former Cross 7 area before Arawa had invaded it. The committee envisaged, moreover, a discount against Arawa should its undue spread threaten flour quality.

In the event, the remarkable doubling of the wheat acreage in one season, was accompanied by a far reaching replacement of Cross 7 by Arawa and bakers and millers became alarmed at the possible effect on flour quality. As a result, when in December the institute suggested to the millers that it should make available to grain merchants a fast testing service that would allow lines to be tested before submission to millers, the millers at once accepted. It was recognised that there were many possible causes of failure of the service external to the laboratory. At the peak of the harvest over 350 samples were received and tested per day, and the total for the whole harvest was over 5,000. Fears of farmers and merchants that the testing would mean serious delays in handling the harvest proved to be unjustified for it appeared very soon that the rate at which the wheat could be handled into stores was lower than the rate of testing and that collection of samples and transmission of reports could be done fast enough. As it happened the baking quality of Arawa wheat in the harvest was much higher than it had been in the two previous seasons, but the testing service was welcomed by millers because it had the effect of raising the average quality of Arawa through the elimination of a small proportion of poor lines that would otherwise have been used for milling.

The main gain from the application of the Zeleny test was the knowledge that the problems external to the laboratory did not stand in the way as many had expected. This means that investigations can now be undertaken on testing methods without the fear that organisation problems will in any case prevent their proper use. As a result it can be expected that the new Hagberg test for sprout damage in wheat will be applied in the next season in which sprouting becomes a problem. If this could be done millers would be able to take a higher proportion of sprouted wheat lines than at present.

This trend towards the testing of wheats before their acceptance at mills is significant from many points of view. Bulk handling for example could not be safely undertaken in a general way unless the wheat lines can be tested in time for them to be placed in appropriate bins on arrival at the mill silo.

INFORMATION BUREAU

The editing and publishing of departmental publications and the maintenance of the Central Library, Technical Information Section, Translations, Publicity, and Photographic and Photocopy Section are the responsibility of the Information Bureau.

The first volumes of the three new journals (which replaced the *New Zealand Journal of Science and Technology*) have been published – they are the *New Zealand Journal of Agricultural Research*, the *New Zealand Journal of Geology and Geophysics*, and the *New Zealand Journal of Science*. The first named is published in alternate months and the other two quarterly. The policy regarding material to be published is that articles are required to be based on original scientific work carried out in New Zealand or on New Zealand material or, in special cases, to have some other connection with New Zealand. The field covers practically all branches of pure and applied science.

As an indication of the increasing quantity of material being submitted for publication in the journals there has been, for example, in the field of agricultural research, a fourfold increase in 10 years and a 50-per-cent increase since the inauguration of the new journals a year ago.

During the past year the Bureau has, in addition, edited and published 25 bulletins and other publications on behalf of branches of the Department.

The Central Library is generally recognised as one of the best scientific libraries in the Dominion and much work has been done by the library staff to raise the level of special librarianship in New Zealand, e.g., by lecturing and tutoring at the N.Z. Library School and through the N.Z. Library Association. Many students (including Colombo Plan students), are given short periods of training.

The number of scientific periodicals now being published in the world is of the order of 50,000 (titles). To this must be added a vast number of bulletins, pamphlets, reports, and other publications. The proper retrieval of this information for research workers and other users now requires specially trained scientific librarians and modern techniques (beyond the normal training of scientific workers). If these are not available, research workers could be seriously handicapped.

Over 600 major technical inquiries directed to the Department have been dealt with by the Technical Information Section in the year. Approximately half of these were from manufacturers, and over one-third from Government Departments and local authorities. The Technical Information Officer keeps in close touch with scientific officers, and with the Scientific Liaison Offices in London and Washington. Collaboration with overseas information agencies has been still further extended and a large amount of valuable technical literature is constantly received as a result. The Technical Information Officer now acts as the New Zealand Liaison Officer of the United States International Cooperation Administration and of the European Productivity Agency in Paris.

The *Industrial Bulletin* is published jointly by this Department and the Department of Industries and Commerce. Approximately 300 abstracts and scientific and technical articles were contributed to it during the year, and 200 requests were subsequently received for fuller information on subjects dealt with.

The Technical Information Officer is also doing a certain amount of special translation work. He often acts as interpreter for visiting scientists, to the Courts, the Police, the Film Censor, etc.

A new underwater camera, which the Photographic Section designed and tested, has been used with great success in taking the first photographs of the sea bed in McMurdo Sound in the Antarctic. The camera was used in depths down to 200 fathoms. This camera was also used to obtain information on the sea bed in the Cook Strait area.

SCIENTIFIC LIAISON SERVICE

Scientific Liaison Offices are maintained by the Department in London and Washington. In both capitals the Department's representatives are associated with scientific liaison officers from other parts of the Commonwealth to form a British Commonwealth Scientific Office (B.C.S.O.). This association has been of outstanding benefit to all concerned and has been an important factor in facilitating Commonwealth cooperation in scientific matters.

The Department's Liaison Offices are responsible for keeping New Zealand research workers advised of the most recent, relevant, and important scientific work being carried out overseas. The receipt of this information, much of which would not be available through normal channels, assists the Department and its officers in formulating and modifying research programmes.

The Senior Scientific Liaison Officer in London, in addition to other duties, arranges and gives oversight, in the United Kingdom, to members of the New Zealand Defence Scientific Corps and to New Zealand National Research Fellows, represents New Zealand on a number of Commonwealth scientific committees, and acts in an advisory capacity in scientific matters to the High Commissioner's Office.

The Department is indebted to overseas research organisations and other bodies for the assistance they have given so generously to our liaison staff.

CONCLUSION

The Department has continued to receive generous cooperation from other State Departments, the Cawthron Institute and the university colleges, overseas scientific organisations, and from both farming and manufacturing interests. The good relations that have prevailed have been much appreciated and have greatly assisted the promotion of the Department's objectives.

In conclusion, I would thank the staff of the Department for their help and cooperation during the year, and also express my personal indebtedness to the Council of Scientific and Industrial Research and its advisory committees for the assistance they have generously rendered on all occasions.

W. M. Hamilton, Secretary.

BRANCHES

ANIMAL ECOLOGY SECTION

Officer in Charge: Dr K. Wodzicki

PROJECTS

Research on Mammals

Rabbits—Long-term investigations of reproduction and parasites; geographic distribution of rabbit nematodes in the North Island; rabbit population ecology in Wairarapa; census techniques; age determination by the sequence of bone fusion; observations on stress in wild rabbit populations; and studies for a history of the rabbit in New Zealand.

Rats—The rat - wild cat - petrel relationship on Little Barrier Island; studies of rats in New Zealand native forests; distribution of rats in New Zealand and dependencies; and breeding of kiore in captivity.

Research on Birds

The role of native and introduced birds in natural control of insect populations in Kaingaroa and Ngaumu forests; the effect of control measures on the rook populations in Canterbury and Hawke's Bay.

Surveys

Changes in bird and mammal populations due to land development in Western Taupo; effect of the removal of rabbit on bird life of Motunau Island.

PUBLICATIONS

The Rabbit Problem in New Zealand. *N.Z. Dep. sci. industr. Res. Inf. Ser. 16*:1958. Walter E. Howard.

Incidence of Coccidia (Sporozoa) in Wild Rabbits, *Oryctolagus cuniculus* (L.), in Hawke's Bay, New Zealand. *N.Z. J. Sci. 1*:289–329. 1958. P. C. Bull.

Black-backed Gull – A Gannet Predator. *Notornis 8 (1)*:22–23. 1958. R. H. Taylor and K. Wodzicki.

Migration and Dispersal of New Zealand Gannets. *The Emu 58 (4)*: 289–312. 1958. Kazimierz Wodzicki and Peter Stein.

Rabbit's Life History and Habits. *N.Z. Young Farmer 11 (2)*:35–36. 1959. J. S. Watson.

Observations on the Food of the Hedgehog (*Erinaceus europaeus* L.) in New Zealand. *N.Z. J. Sci. 2*:121–136. 1959. Robert E. Brockie.

APPLIED MATHEMATICS LABORATORY

Director: Dr R. M. Williams

PROJECTS

Industrial and operational research projects include statistical work on problems in the heavy clay industry, in airline reservation systems, and the timber industry; mathematical-physical work on the operation of tunnel-kilns; the firing of clay bodies; metallurgical and conduction problems in the geothermal project; and the spontaneous combustion of wool bales.

In agriculture, statistical work has been done on a variety of problems such as long-term investigations into the residual effect of fertiliser, problems of aphid control, plant ecology, pasture growth, plant viruses, facial eczema, ecology of rabbits and deer, wool production, and a variety of problems in mathematical genetics with applications to plant and animal problems such as the estimation of genetic components of variance, mixed random and sib-mating, and the inheritance of quantitative characteristics of ryegrass.

Miscellaneous statistical work includes police statistics, educational testing, fluctuation of overseas meat prices, assessment of accuracy of toxicological analysis of arsenic in human liver, auroral studies, rainfall and micro-climate data, analysis of run-off measurements for soil studies, analysis of a variety of problems affecting health including cancer incidence, sampling of milk, bacteriological studies of water, the effect of pressure on workers on the Auckland Harbour Bridge, and the histories of psychopathic patients.

Basic mathematical work has been done in a number of problems arising out of the above, including studies in distributions occurring in ecology, time series, and statistical test theory.

PUBLICATIONS

Doppler Measurements on Soviet Satellites. *N.Z. J. Sci. 1*:143–153. J. E. Drummond.

Prediction of the Firing Deformation of Ceramic Bodies. *N.Z. Pottery and Ceramic Res. Assn. Tech. Report. No. 10.* D. S. Adcock, J. E. Drummond, and I. C. McDowall with a note by J. T. Linzey.

The Tiller Population of Pastures. *N.Z. J. Agric. Res. 1*:305–318. K. J. Mitchell and A. C. Glenday.

Appendix to: Further Breeding Experiments with New Zealand Romney *N*-type Sheep. *Aust. J. Agric. Res. 9*: 361–362. A. C. Glenday.

The Theory and Analysis of Diallel Crosses II—*Genetics 43*:63–85. B. I. Hayman.

The Separation of Epistatic from Additive and Dominance Variation in Generation Means. *Heredity 12*:381–390. B. I. Hayman.

The Effect of Certain Meteorological Conditions on Sturmer Apple Yields. *J. Hort. Sci. 33*:228–236. H. S. Roberts.

The Analysis of Particle Counts by the Spray Drop Method. *Brit. J. Appl. Phys. 9*:264–276. K. I. Williamson and W. B. Taylor.

The Statistical Study of Plant Distribution Patterns Using a Grid of Quadrats. *Aust. J. Bot. 6*:322–342. H. R. Thompson.

Note on the Efficiency of Aphid Trapping. *N.Z. J. Sci. 1*:614–616. H. R. Thompson.

Continuous Generalisation of Tchebichev's Inequality. *Theory of Probability and its Applications 3*:386–394. P. Whittle.

A Multivariate Generalisation of Tchebichev's Inequality. *Quart. J. Math. 9*:232–240. P. Whittle.

On the Smoothing of Probability Density Functions. *J. Roy. Stat. Soc. B20*:334–343. P. Whittle.

An Experiment on Free Thermal Convection of Water in a Saturated Porous Medium. *J. Fluid Mechanics 3*:582–600. R. A. Wooding.

AUCKLAND INDUSTRIAL DEVELOPMENT LABORATORIES

Director: Mr J. B. Brooke

PROJECTS

Medical Instrumentation Group—Modifications and additions to Melrose heart-lung machine; design of twin channel bronchospirometer; transistorised body temperature recorder; multi-channel oesophageal pressure recorder; construction of positive-negative pressure respirator for anaesthetics; methods of determination of oxygen content of amniotic fluid; equipment for detection of breathing failure in premature infants; equipment for recording respiratory loops; construction of radon seed applicator; improvements to X-ray isodose recorder; improvements in blood pressure recording equipment; development of 300 c.c. pump for gastric cytology; and homogeniser for human milk.

Fuel Group—Examination and advice on correction of heat losses in steam raising and using equipment; assistance with calibration of instruments; special measuring techniques; investigation of open storage properties of a Waikato coal; and advice on storage and use of fuels.

Foundry Group—Investigation of chemical reactions taking place in cupolas, with special reference to coke size and quality; investigation of the factors producing gas porosity in grey iron castings; investigation of metal-mould reactions during sand casting of copper based alloys; investigation of permissible limits of impurities in copper based alloys, such as may be encountered in locally made secondary metal ingots; investigation of metal cleaning and gas scavenging techniques for cast iron and copper based alloys; and development of moulding sands for special purposes.

Design and Workshop Sections—Design and construction of tissue culture machine; coke shatter tester; rope testing equipment; grit sampling equipment; spore collector; rope preforming grips; earthenware pipe gauging equipment; label cutting dies; piston ring wear investigations; timber testing equipment; animal cephalometer; winches, sampling tubes, etc., for oceanographic work; transducers and associated equipment; defibrillator electrodes; precision pressure gauge testing unit; and strain gauge lathe tool dynamometer. Investigations into: failure of paper roll lifting clamp; failure of large hammer-head crane bearing; faults in label-cutting machine; efficiencies of vee-belt drives; efficiency of new form of crutch tip; failure of door eye-bolts in timber treatment pressure chamber; failure of excavator gear train; and failure of bevel drive gears in gyratory stone crusher. Design details were provided for: washing machine gears, and load distribution in asbestos cement products autoclave. Balancing work was carried out on oil purifiers, and on several large motors and brush rollers in insulating board manufacture. Dynamic strain measurements were made on crane girders, gyratory stone crusher, and sheet piling, and also to give a continuous record of the weight of plaster in a hopper.

Physics Section—Behaviour of materials under controlled environmental conditions (includes wood, plastics, paper, etc.); investigation of acoustical properties of buildings; industrial grit sampling with improved equipment; vibration due to quarry blasting; experimental

temperature and humidity controlled cabinets; investigations into the freezing of pears; measurement of sap flow in conifers by a heat transport method; and tests to specifications.

Industrial Liaison Section—Symposia were held in conjunction with the Seddon Memorial Technical College on "Developments in Industrial Measurements" and "Corrosion in Industry." Lectures on the work of the laboratories and on various phases of science in industry were given to Rotary Clubs, groups of manufacturers, chambers of commerce and the Institution of Engineers. Educational talks were given to the teachers' training college on the "History of Automation" and to senior apprentices on "Recent Developments in Mechanical Engineering". The laboratories were represented at a number of industrial conferences and visits to the laboratory were arranged for several interested groups.

The following general projects were handled by the group: investigations of mal-functioning of corrugated fasteners for *Pinus radiata* in the box-making industry; report on the conversion of strip roll forming machinery; and examination of plastic tubing for dimensional variation.

PUBLICATIONS

Properties of Foundry Sands Found in the Auckland Area. *N.Z. Engineering 13 (6)*:217–218. E. D. Burt and P. A. Neyland.

Properties of Foundry Sands Found in the Auckland Area. *N.Z. Dep. sci. industr. Res. Inf. Ser. 20*: E. D. Burt and P. A. Neyland.

Vacuum or Low Pressure Seal Utilising Modified Standard Refrigeration Type Flare Fittings. *Journal of Scientific Instruments 35 (5)*:182. B. H. Hodder.

A High Stability Mains Operated Thermistor Thermometer. Ibid. *35 (5)*:179–180. A. W. Melville and J. Boyes.

A Drip Rate Recorder for Intravenous Solutions. *Electronic Engineering*: 606–607. 1958. A. W. Melville and J. B. Cornwall.

A Servo Operated Respirator for Premature Infants. *I.R.E. Transactions on Medical Electronics*: 75–81. 1958. A. W. Melville and B. H. Hodder.

Measurement of Sap Flow by Heat Transfer. *Nature 182*:878–879. D. C. Marshall.

Measurement of Sap Flow in Conifers by Heat Transport. *Plant Physiology 33 (6)*:385–396. D. C. Marshall.

BOTANY DIVISION

Director: Dr E. J. Godley

PROJECTS

Herbarium—Maintenance and expansion of indigenous, adventive, and cultivated plants sections of herbarium; accessions of specimens of indigenous plants from Nelson Lakes, Mt. Cook, and Fiordland National Parks; collection and distribution of seeds of indigenous plants; and annual issue of *Index Seminum*.

Botanic Garden—Development of garden continued at Lincoln with provision of more facilities and bringing in of more land; increased amount of plant material under observation, and additional species to

the permanent growing reference collection of plants; trials continued with plants for shelter purposes, and stock prepared in nursery for planting up surrounds of new laboratory building.

Taxonomic Studies—Work on families of Volume I of the revised *Manual of New Zealand Flora* is almost complete; preparation of a monograph of the New Zealand grasses; preparation of a *Flora of Adventive Plants in New Zealand* continued; monograph of the Australasian species of *Callitriche* completed and submitted for publication; investigation of species of *Ligustrum* (privet) used horticulturally as rootstocks for lilac completed; revision of indigenous alpine species of *Ranunculus* in progress.

Vegetation Studies—Vegetation surveys of Nelson Lakes, Mt. Cook, and Fiordland (in cooperation with University of Otago) National Parks commenced; vegetation of Southern Chile (part of Royal Society Darwin Centennial Expedition investigations); vegetation survey of Hutt River catchment; periodic examination of specific sites, Molesworth; aquatic vegetation of Waikato Basin.

Chromosome Studies—Preparation of chromosome atlas of indigenous plants continuing.

Quaternary History—Pollen and macrofossil analyses of Canterbury and Waikato peats; pollen morphology of indigenous Podocarpaceae and Umbelliferae; accessions of pollens of indigenous, adventive, and cultivated plants to permanent reference slide collection.

PUBLICATIONS

Resistance to Yellow-leaf Disease in *Phormium tenax* Forst. and the Occurrence of Delayed Expression of Symptoms. *N.Z J. agric. Res. 1*:31–36. W. R. Boyce.

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Eelworm (*Anguina agrostis* (Steinb.) Filijer) in *Agrostis tenuis* Sibth. in New Zealand. *N.Z. J. agric. Res. 1*:265–266. A. J. Healy.

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Contributions to a Knowledge of the Adventive Flora of New Zealand, No. 6. *Trans. roy. Soc. N.Z. 85*:531–549. A. J. Healy.

Contributions to a Knowledge of the Adventive Flora of New Zealand, No. 7. Ibid. *86*:113–118. A. J. Healy.

Foods of the Australian Opossum (*Trichosurus vulpecula*, Kerr) in New Zealand Indigenous Forest in the Orongorongo Valley, Wellington. *N.Z. J. Sci. 1*:590–613. R. Mason.

Notes on the Botany of the Auckland Islands. Ibid. *1*:466–479. N. T. Moar.

Contributions to the Quaternary History of the New Zealand Flora. 1. Auckland Island Peat Studies. Ibid. *1*:449–465. N. T. Moar.

Contributions to the Quaternary History of the New Zealand Flora. 2—Plant Remains from a Buried Peat Layer at Bowenvale, Christchurch. Ibid. *1*:480–486. N. T. Moar.

Pollen-analysis of a Post-glacial Peat Bog. In "The Flora of Cass." Part II. 1. 1958, pp. 4. (Mrs) P. E. Young and N. T. Moar. (Published by Botany Dept. Univ. of Canterbury.)

Index Seminum, Anno MCMLVIII Collectorum.

CROP RESEARCH DIVISION

Director: Dr L. Corkill

FIELD-CROP PROJECTS

Wheat Breeding—A general-purpose wheat similar to Aotea in yield but with higher baking quality; an early-maturing red-grained rust resistant variety that will not lodge, to replace Tainui and Gabo in the North Island; a high-yielding wheat with better baking quality to replace Arawa on high-fertility land; a high-quality wheat like Hilgendorf with greater yield; lines of commercial varieties resistant to mildew; drought resistant wheats for light land; and lines resistant to cereal yellow-dwarf virus.

Wheat Genetics—Inheritance of kernel weight, grain-shattering, protein, mildew resistance, purple grain colour, and production of supernumerary grains.

Oat Breeding—Lodging resistant milling oats; lines of commercial varieties resistant to crown rust; and introduction and testing of overseas varieties.

Oat Genetics—Inheritance of hull type and seedling chlorosis.

Barley—Introduction and testing of new overseas varieties.

Ryecorn—Breeding for improvement of forage and seed yield of C.R.D. ryecorn.

Potato Breeding—Resistance to blight (*Phytophthora infestans*), scab, and pink rot (*P. erythroseptica*); resistance to viruses X, Y, and leafroll; and improved agronomic characters.

Virus-free Stocks of Potatoes—Selection of virus-free plants of commercial varieties and maintenance of nucleus stocks; and annual testing of virus-free stocks that are being increased by the Department of Agriculture.

Potato Virus Diseases—Study of the natural spread of virus diseases; study of strains of viruses X and Y; methods of testing for virus content and virus resistance; study of the nature of resistance and of gene action; the effect of environment upon resistance; and study of potato aphid population in Canterbury throughout the growing season.

Potato Blight—Study of blight strains in New Zealand and of their origin; study of the nature of resistance and of gene action; and the effect of environment upon resistance.

Agronomy—Effect of irrigation and other agronomic practices upon potato yields.

Swede Breeding—Resistance to dry rot and club root.

Swede Genetics—Inheritance of split cotyledon and split petals.

Rape Breeding—Resistance to aphids.

Turnips—Searching for resistance to cauliflower mosaic and breeding for club-root resistant green globe type.

Cabbage Aphids—Population studies on resistant and susceptible hosts.

Lucerne—Investigation of factors that determine when different varieties commence growth in the spring; selection of an early strain of lucerne with good agronomic features; breeding lucerne that combines earliness with high production and resistance to eelworm; selection of lucerne capable of growing during drought periods; breeding creeping rooted lucernes with high productivity and extended growing season; testing lucerne varieties sold in New Zealand; investigating the relationships of yield components in spaced plants and swards; and investigations on seed production.

Lupins—Breeding of yellow and blue lupins for rapid early growth, low alkaloid content, high seed production, and non-shattering pods.

Linseed—A rust resistant variety has been produced and a seed supply obtained for field testing.

VEGETABLE PROJECTS

Breeding and Selection—Club-root resistance in cabbage and cauliflower; selection for uniformity in spring cabbage and cauliflower; white rot resistance in onions; rust resistance in three pole bean types; mosaic immunity in wilt-resistant peas; spotted wilt resistance in outdoor tomatoes; and mosaic resistance and leaf mould resistance in glasshouse tomatoes.

Variety Trials—Assessment of growth and yield characters in sprouting broccoli; trials of U.S. F1 hybrid onions; carrot-fly reaction of varieties and species; and evaluation of New Zealand rhubarb varieties.

Other Projects—Effects of mosaic on cauliflower yield and quality, and investigations on control measures; vegetative propagation methods in brassicas as an aid to breeding programmes; factors influencing seed yield of brassicas in glasshouses – an adjunct to pure seed production; and the collection of Pacific kumara.

BIOCHEMISTRY AND PHYSIOLOGY PROJECTS

Metabolism in Kale—Changes in glutamic acid metabolism have been noted in maturing kale plants. These changes produce large amounts of free proline, the presence of which in the free state is particularly associated with the reproductive phase in plants.

Rhubarb Varieties—Very large amounts of soluble and insoluble oxalates have been noted in some rhubarb lines, indicating that care must be exercised in the choice of variety for table use. As a source of Vitamin C, rhubarb does not appear to be nutritionally important.

Kumara Varieties—Kumara varieties are being investigated with a view to establishing bio-chemical differences in composition, and evaluing them in human nutrition.

Growth Substances—An officer is at present overseas studying the effect of plant hormones upon ion transport and taking part in the isolation and characterisation of an endogenous inhibitor which he discovered in lupin tissues.

Root Culture Studies—Root culture studies have commenced. Chloride deficiency symptoms have already been noted at quite high levels in tomato root culture experiments.

NUCLEUS SEED PRODUCTION

This year pure seed of 25 field crop varieties has been produced to provide nucleus seed for the seed certification scheme of the Department of Agriculture. Nucleus seed of nine vegetable varieties has been grown for increase and distribution under the Vegetable Seed Approval Scheme.

PUBLICATIONS

Antirrhinum Rust in New Zealand. *N.Z. J. Agric. 97 (6)*:551–552. R. Close.

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Improved Pasture Plants Aid Production. *N.Z. Young Farmer 11 (3)*: 91–93. L. Corkill.

The Development of Better Pasture Plants. *Proc. 8th Lincoln College Farmers Conference, 1958*. L. Corkill.

Races of Potato Blight, *Phytophthora infestans* (Mont.) de Bary, in New Zealand. *N.Z. J. agric. Res. 1*:527–530. C. M. Driver.

The Progress of Potato Breeding in New Zealand. *Australian Country*. Jan., 1959. C. M. Driver.

Omega Savoy Cabbage – Crop Research Division's Strain Released. *N.Z. Commercial Grower 14 (6)*:4. H. J. Giesen.

The Effect of Leaf Rust on the Growth and Chemical Composition of Oats and Ryecorn. *J. agric. Sci. 50 (1)*: 66–72. A. F. Greenall.

Studies of Grazing of Crop Forages by Sheep. 1 – The Effect of Grazing on Composition, Digestibility and Nutritive Value of Rape. *N.Z. J. agric. Res. 1*:569–581. A. F. Greenall.

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Characters which Distinguish Aotea Wheat from Cross 7. *N.Z. J. Agric. 96 (4)*:318. J. M. McEwan.

Drought Resistance Studies in Relation to Wheat Breeding in New Zealand. *N.Z. Wheat Review No. 7*:57–59. J. M. McEwan.

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The Wheat Varieties of New Zealand. *N.Z. Dep. sci. industr. Res. Bull. 131*. J. M. McEwan.

In Search of a Plant – Choice of Lucerne Variety to Suit Local Conditions. *N.Z. Young Farmer. 10 (4)*:19–20. T. P. Palmer.

Split Petals in Crucifers. *Heredity 12 (4)*:417–428. T. P. Palmer.

Straight-growth Inhibitors in Glucose. *Nature 182*:950–951. R. F. M. Van Steveninck.

Factors Affecting the Abscission of Reproductive Organs in Yellow Lupins. 11 – The Effect of Growth Substances, Defoliation, and Removal of Lateral Growth. *J. Expt. Botany 9*:372–383. R. F. M. Van Steveninck.

Grain in the Glume of Wheat. *Nature 181*:1812–1813. G. M. Wright.

Effect of Gibberellic Acid on Compactoid Wheat. *Wheat Information Service No. 7*:12–13. G. M. Wright.

Wheat in Canterbury: Cropping Practices and Disease. *N.Z. Wheat Review No. 7*:25–42. G. M. Wright.

New Glasshouse Tomato, V548, to be Released this Year. *N.Z. Commercial Grower 14 (8)*:4. D. E. Yen and F. J. Newhook.

New Zealand Wheat Review No. 7.

DIVISION OF NUCLEAR SCIENCES

Director: Mr T. A. Rafter

PROJECTS

Sulphur isotopes; radiocarbon dating; $^{13}C/^{12}C$ isotopic variation in nature; carbon isotopic exchange rates; well-logging and industrial tracers; nitrogen uptake studies; ^{14}C natural variations; cosmic ray variations; tritium as a tracer for water movements; the construction and installation of a 240 curie cobalt source; radioactive fall-out studies; potassium-argon age measurements; energy transfer mechanisms; theoretical studies; metabolic paths in nature; and carbon isotope enrichment.

PUBLICATIONS

Teflon Sheet as a Large Area Gas Seal for Gas Flow Radioactivity Counters. *Rev. Sci. Instr. 29*: 536–7. K. A. Bargh.

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Selection of Bulls for Artificial Breeding on Basis of Semen Storage Characteristics. *Jour. agric. Sci. 50*:260–6. M. C. Probine, W. J. McCabe and P. Shannon.

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The Fractionation of Stable Isotopes of Sulphur by Thiobacilli. *Nature 127*:517–518. I. R. Kaplan and T. A. Rafter.

DOMINION LABORATORY

Director: Mr F. J. T. Grigg

PROJECTS

Organic Chemistry—Diphenylamine and phenothiazine residues on and within apples; separation and identification of non-protein nitrogen constituents of ryegrass; the uptake of arsenic by bacon and fish when smoked with smoke from arsenical timber; chemical methods for the determination of both large and micro amounts of organic phosphorus pesticides; study of methods for determining mercury in pesticides; forensic and toxicological investigations; and dieldrin in human body fat.

Food and Drugs—Bacteriological examination of food and drugs; detection and determination of preservatives; detection and identification of food colours; determination of trace metals in food; and analyses of water for potability, for fluoride content, and for stream pollution.

Paint—Durability of paint on *Pinus radiata* and tawa weatherboards; the effect of preservative treatments on paint durability; natural wood finishes for exterior use; high-gloss paints for exterior use; painting of structural steel; and underwater paints for hydro-electric installations.

Wood Chemistry—A study of the essential oil constituents of New Zealand grown exotic pines to determine: (a) variability in composition within a tree; (b) reproducibility of composition within pure stands; and (c) extent of hybridisation between pure stands. Elucidation of chemical structure of an unknown hydroxylated diterpene from *Dacrydium colensoi,* and studies of manool and the isomer manoyl oxide.

Infrared—Studies associated with facial eczema research; estimation of *trans* unsaturation in impure fatty ester fractions; identification of individual barbiturates; and the recognition of polymorphism by the infrared spectrum.

Inorganic Chemistry—Solubility and conductivity of aqueous electrolytes above 100°c; PVT relationships in the CO_2/H_2O system; oxidation products of sulphur in nature; study of major constituents and trace metals in geothermal bore fluids; and analysis of rocks from Antarctica.

Petroleum—Methods of detection and analysis of dyes in tax-refundable petrol; adhesion agents for bituminous road binder materials; timber preservative oils; and oil deterioration in vacuum dehydration of transformers.

Cement and Concrete—Study of hydration of cements by differential thermal analysis; use of diatomite as a pozzolan; development of sulphite waste liquor as a concrete additive; and study of characteristics of New Zealand produced cements.

Metallurgy—Fatigue in aircraft structures; fluidised bed reduction of ironsands; metallurgical problems in geothermal steam, including hydrogen diffusion through steel and stress rupture; crevice corrosion theory; and technical advice on iron and steel production in New Zealand.

Physical Chemistry—Phase changes induced in crystals by mechanical distortion; quantitative aspects of X-ray diffraction; wavelength calibration of spectrophotometers; rapid analysis of water in wool; safety of slipemaster wool; and self-heating of wet wool.

Chemical Engineering—Measurement of steam/water ratios in geothermal bores; reforming of natural gas; processing of pozzolan; hydrochloric acid production by ion exchange; salt recovery from geothermal bore water; and survey of the fish industry.

Coal—Fusion characteristics of coal ashes; development of "Autofeed" stoker; stokermatic heating equipment; pulverised fuel firing and briquetting of New Zealand coals; volatiles evolved from coal at 150°c; and analyses of coal for Japan.

District Laboratories—Chemical and bacteriological examination of foods, drugs and waters; phosphatase in milk; non-fat solids in town milk; river and harbour pollution; atmospheric pollution; and forensic and toxicological science.

PUBLICATIONS

Podocarpus spicatus Heartwood Extractives. *N.Z. J. Sci. 1*:220–223. H. V. Brewerton.

Modifying KBr Die Aids Pressing Thin Discs. *Perkin-Elmer Instrument News for Science and Industry 9*:8. B. Cleverley.

Occurrence of *trans*-Unsaturated Acids in the Faecal Lipids of Ruminants and Non-Ruminants. *Biochem. J. 69*:1–5. L. Hartman, F. B. Shorland, and B. Cleverley.

Detection of Food Preservatives by Paper Chromatography. *N.Z. J. Sci. 1*:412–416. A. C. Cocke.

The Australian Scene. *Gas Newsletter (6)*:6–7. F. J. T. Grigg.

Determination of Diphenylamine Residues on Apples. *N.Z. J. Sci. 1*: 378–382. H. E. Harvey.

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The Kinetics of Absorption of Carbon Dioxide into Neutral and Alkaline Solutions. *Chemical Engineering Science 8*:201–215. P. V. Danckwerts, and A. M. Kennedy.

A Borehole Survey of Ilmenite-bearing Beach Sands at Cape Foulwind, Westport. *N.Z. J. Geol. Geophys. 1*:318–324. T. Marshall, R. P. Suggate, and D. S. Nicholson.

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Stress Corrosion of Austenitic Stainless Steel in Geothermal Steam *Corrosion 14*:59–62 (159t–162t). T. Marshall.

Brushite Nodules and Hydrogen Swells in Defective Canned Cheese Paste. *Analyst 83*:539–540. D. F. Nelson.

Borehole Survey of North Island Ironsands from New Plymouth to Kaipara Harbour. *N.Z. J. Geol. Geophys. 1*:617–634. D. S. Nicholson, and H. E. Fyfe.

Ilmenite Deposits in New Zealand. *N.Z. J. Geol. Geophys. 1*:611–616. D. S. Nicholson, J. J. S. Cornes, and W. R. B. Martin.

Utilization of Coal in New Zealand. 1920–1955. *N.Z. Dep. sci. industr. Res. Inf. Ser. 19*. D. S. Nicholson.

The Application of Gas Chromatography to the Analysis of Gases. *N.Z. Institute of Chemistry Journal 22*:134. J. B. Ross.

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The Use of Drying Oils in Paint. *N.Z. Institute of Chemistry Journal 22*:123–124. R. M. Sinclair.

Mercury Content of Tomatoes. *N.Z. J. Sci. 1*:373–377. H. M. Stone and P. J. Clark.

Pesticide Residues in Fruit. *N.Z. Institute of Chemistry Journal 22*:116. H. M. Stone.

Cyclic Gasification of Sub-bituminous Coal. *Coke and Gas*:197–201, 1958. P. A. Toynbee.

Fertilizers from Coal. *N.Z. Coal 2*:5, 36. P. A. Toynbee.

High-pressure Gasification of Coal. *N.Z. Electrical Journal 31*:171–174. P. A. Toynbee.

Long-distance Transmission of Gas. Ibid. *31*:137–140. P. A. Toynbee.
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Vertical Distribution of Sewage in Waitemata Harbour. *N.Z. J. Sci. 1*: 23–34. G. M. Wallace, L. E. Newman, and J. L. Jerrome.
Arsenic Contamination of Bacon by use of Treated Sawdust in Smoking. *N.Z. Institute of Chemistry Journal 22*:116–117. C. C. Watson.
The Contamination of Bacon by Arsenic from Smoke Derived from Preservatized Wood. *N.Z. J. Sci. 1*:361–368. C. C. Watson.
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The Dichromate-lignosulphonate Reaction and its Potential use in Chemical Grouting. Ibid. *1*:9–17. A. Weston and R. A. Kennerley.
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DOMINION PHYSICAL LABORATORY

Director: Mr W. H. Ward

PROJECTS

Electron Microscopy—Investigation of structure of dentine and enamel in sheep's teeth to find the reason for the improved pastures causing excessive rate of wear; electron micrographs for Government Departments, research associations, and firms, etc., of clay colloids, zinc oxides, insect virus, soil bacteria, chloroplasts, clover virus, firing clays, metal surfaces, gypsum plaster, and pollen grains; and cytology of the spermatogenesis of the cave weta.

Engineering Seismology—Examination of bearing-wall structures; examination of multi-storey yield; examination of multi-storey yield and friction damping; framing of a seismic building code; and maintenance of earthquake recorders and building instruments to get data on actual earthquake performance.

Heat Transfer—Measurement of thermal conductivities; general advice on thermal insulation and heat problems; investigation into utilisation of solar energy for house heating and domestic hot water supply; and development of models of geothermal systems.

Instrument Development—Testing and calibration of anemometers; design and development of specialised apparatus not available commercially; and instrument technology and automatic control devices.

Optical Design—Theory of lens design; design and use of aspheric surfaces; and theory and design of economical prism systems of large aperture.

Plant Physics—Investigation into the design of ion exchange humidity elements; further studies of the ripening disorders of tomatoes caused by environmental conditions; the effects of surface wetting of leaves on transpiration; the effects of cultivation techniques on the tension-moisture relationships of soils; the mechanical properties of plants and plant tissues; and studies on climbing plants.

Radio Research—Use of a frequency standard in the study of long distance ionospheric propagation at very low frequencies; measurement of ionospheric winds; measurement of radio "whistlers" and similar phenomena; use of radar in the study of auroral ionisation, in conjunction with a wide programme of auroral studies using visual photographic and spectroscopic methods; study of radio propagation through the auroral zone; and study of the lower ionosphere using V.H.F. forward scatter.

Standards—Establishment of standards of physical measurement in length, mass, force, temperature, pressure, photometry, radiation, and air velocity; maintenance of standards of electrical quantities, and the examination and calibration of substandards against the national standards; the setting up of standards of reactance; the development of methods of measuring electrical quantities at radio frequencies; and maintenance of the standard-frequency radio transmissions.

General—Development of an electronic correlator; development of apparatus to study the effect of wind on sea waves; tests (mainly electrical) to encourage improved quality in New Zealand commodities; advice on problems in acoustics; development of an aspheric grinding machine; and development of an automated plant for industrial heat treatment of metals.

PUBLICATIONS

Some Relations to be Expected Between the Directional Spectra of Swell Observed at Different Times and Places on the Ocean. *N.Z. J. Sci. 1*: 330–41. N. F. Barber.

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Loss of Moisture from Vegetation. *Nature 181*:1619–20. R. L. Closs and K. J. Mitchell.

Differences between the East-West and West-East Propagation of V.L.F. Signals over Long Distances. *J. Atmos. Terr. Phys. 12*:110–7. D. D. Crombie.

Phase Variations of 16 kc/s Transmissions from Rugby as Received in New Zealand. *Proc. Instn. elect. Engrs. B105*:301–4. D. D. Crombie, A. H. Allan, and Miss M. Newman.

New Zealand's Frequency Standard. *N.Z. Engineering 13*:327–8. A. H. Allan, and D. D. Crombie.

A Closing High-speed Plankton Catcher for Use in Vertical and Horizontal Towing. *Pacific Science 12 (1)*:46–59. B. M. Bary, J. G. De Stefano, M. Forsyth, and J. van den Kerkhoff.

Selection of Bulls for Artificial Breeding on Basis of Semen Storage Characteristics. *J. agric. Science 50*:260–6. M. C. Probine, W. J. McCabe, and P. Shannon.

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The Geometry of Auroral Ionization. *J. Geophys. Res. 63 (3)*:501. R. S. Unwin.

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Electronic Band Structures of the Alkali Metals and of the Noble Metals and Their α-phase Alloys. *Advances in Physics 7*:395–434. M. H. Cohen and V. Heine.

Protoplasmic Streaming and Wall Structure in Nitella. *Nature 182*: 1657–8. M. C. Probine and R. D. Preston.

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Doppler Measurements on Soviet Satellites. *N.Z. J. Sci. 1*:143–53. A. H. Allan and J. E. Drummond.

An Electrical Analogue Method of Predicting the Permeability of Unsaturated Porous Materials. *Brit. J. Appl. Phys. 9*:144–148. M. C. Probine.

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Improvements in Photographic Printing of Electron Micrographs. *J. sci. Instrum. 35*:472. D. M. Hall.

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The Electron Density Distribution in the Outer Ionosphere Derived from Whistler Data. *J. Atmos. Terr. Phys. 13 (3)*: G. McK. Allcock.

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ENTOMOLOGY DIVISION

Director: Dr W. Cottier

MAIN PROJECTS

Grass Grub and Oxycanus—A study of biology, ecology, and factors influencing control of the former, which is our most important insect pest. Observations are continually carried out also on the performance of recommended control measures against the latter.

Argentine Stem Weevil in Ryegrass—The biology, habits, and control are being studied.

Cruciferous Crop Pests—The main problem now is the cabbage aphid which destroys large areas of field crucifers. The population dynamics and ecology of the crucifer aphid complex so important in transmission of virus diseases is being studied.

Insects Associated With Leptospermum Species—A study of manuka blight and its effect on *Leptospermum* spp. The field work on this is nearing finality and it is hoped to have all the important aspects written up this coming year.

Clover Case-bearer—This insect is a serious pest in white clover seed areas. Chemical and biological control are being studied together with the effect of management practices.

Oak Leaf Miner—Two parasites of this pest have been successfully introduced and a start has been made in distributing one of them throughout the country.

Insect Survey—An endeavour is being made to survey, in the North and South Islands, the insects characteristically present on agricultural crops with the object of assessing the importance of the insect complex more satisfactorily.

Survey of Parasites of Crucifer Insect Pests—This is being carried out over a period of years to keep abreast of the biological control position in the field. It has been actively pursued during the seasons 1955–56, 1956–57, and 1957–58, but last season it was necessary to omit it temporarily from our programme in order that the biting-fly project could be started.

Biting Flies—These pests are becoming increasingly troublesome on dairy stock in some North Island districts and during the year investigations were commenced to deal with this trouble.

Development of Forecasting Scheme for Orchard Pests in Nelson—This is an experiment to determine the worth of warning growers about the number of codling moth and leaf-roller prevalent throughout the season as a guide to spraying operations.

Study of Nematodes of Plant and Soil—This is an attempt to place on a more satisfactory basis the work on plant nematodes done in this country. The study of soil nematodes is a new one for New Zealand and is an endeavour to discover the roles played by these organisms in the fertility of different types of soil. Work on the lucerne eelworm, which has become troublesome in the South Island in the last few years, is being carried out.

Study of Army Worms Damaging Pasture and Crops—This is a project to secure information that will help to control these pests which, in the last few years, have become much more widespread in their damage, particularly in the North Island.

Biological Control of Mexican Devil Weed—Insects have been introduced from Australia in an endeavour to prevent the spread of this weed.

Black Beetle—The life and seasonal cycles of this pest of grasslands in parts of the Auckland province are being studied in order to assist in the effective application of control measures.

Systematic Study of Larval Lepidoptera—Work on this is continuing.

Maintenance and Development of Insect Reference Collection—Work is continuing on the building up and improvement of this collection which is basic to the work of the Division.

Identification Service and Advice Concerning Control of Insects—This continues to be an important part of our service work.

OTHER PROJECTS

Leaf miner in ryegrass; virus control of caterpillars; cocksfoot thrips biology and control; sandfly investigations; breeding and distribution of green vegetable bug parasites; apple leaf-curling midge and parasites; collection of ragwort seed fly for Australia; biological control of flies; insect pests of Cook Islands (mainly of citrus); fly control in Niue Island; systematic study of scale insects of genus *Eriococcus*; systematics of *Melolonthinae,* including the larvae and of Thynninae; systematics of aphids and scale insects in general; insect complex in wheat variety trials; cataloguing of New Zealand biological control work.

PUBLICATIONS

Escape Responses of Herbivorous Gastropods When Stimulated by Carnivorous Gastropods. *Nature 181*:137–138. W. C. Clark.

Some Pycnogonida from Cook Strait, New Zealand, with Descriptions of Two New Species. *Zool. Publ. from Vict. Univ. Wellington 23*:7. W. C. Clark.

Notes on the Mantle Cavities of some Trochid and Turbinid Gastropoda. *Proc. Malac. Soc. Lond. 33*:57–64. W. C. Clark.

The New Zealand Species of *Melagraphia* Gray and *Zediloma* Finlay (Mollusca, Gastropoda). *Trans. roy. Soc. N.Z. 85*:659–679. W. C. Clark.

A new Cotylocercous Cercaria from *Melagraphia aethiops* (Gm.) (Gastropoda). Ibid. *85*:681–683. W. C. Clark.

The Insect Complex of Sown Pastures in the North Island—

I—The General Picture Revealed by Summer Sweep-sampling. *N.Z. J. agric. Res. 1*:719–749. R. A. Cumber.

II—The Hemiptera as Revealed by Summer Sweep-sampling. Ibid. *2*:1–25. R. A. Cumber.

The Occurrence of an Argasid Tick in New Zealand. *N.Z. J. Sci. 1*:570–578. L. J. Dumbleton.

The Rhinoceros Beetle as a Regional Problem in the South Pacific. *Proc. 8th Pacific Sc. Congress IIIA*:1325–1327. L. J. Dumbleton.

Bat-infesting *Ornithodorus* (Ixodoidea Argasidae) of the Oriental-Australian Region. *Proc. Linn. Soc. N.S.W. 83*:303–308. L. J. Dumbleton.

Notes on Australian Thynninae. II – The Genera *Dimorphothynnus, Rhagigaster* and *Eirone.* Ibid. *83*:309–326. B. B. Given.

Notes on Australian Thynninae. III – The Genus *Thynnoides*. Ibid. *83*: 327–336. B. B. Given.

Biological Control Factors Influencing Populations of Oak Leaf Miner *Lithocolletis messaniella* Zeller in New Zealand including the Introduction of Parasites. *N.Z. J. agric. Res. 2*:124–133. B. B. Given.

A Note on the Status of *Aphodius tasmaniae* Hope. *Proc. Linn. Soc. N.S.W. 83*:196. B. B. Given.

A Container for Rearing Insects on Potted Plants. *N.Z. Ent. 2 (3)*: 18–19. B. B. Given.

Observations on Behaviour of Australian Thynninae. *Proc. 8th Pacific Sc. Congress IIIA*:1265–1274. B. B. Given.

Observations on Some Habits and Early Development of *Melampsalta cingulata* (Fabr.) (Order Hemiptera, Family Cicadidae). *N.Z. Ent. 2 (2)*:4–11. B. Harford.

Coccids Associated with Rata and Kamahi in New Zealand. *N.Z J. Sci. 1*:179–200. J. M. Hoy.

The Immature Stages of *Eriococcus orariensis* Hoy (Homoptera, Coccoidea). Ibid. *1*:258–280. J. M. Hoy.

Species of *Eriococcus* Targ. (Homoptera, Coccoidea) Associated with the Genus *Leptospermum* Forst. in South-eastern Australia and Tasmania. Ibid. *2*:1–34. J. M. Hoy.

The Final Instar Larva of *Chlorochiton pulcher* (Broun) (Coleoptera Scarabaeidae). *N.Z. Ent. 2 (2)*:15–17. J. H. Hoy.

The Collection of *Hylemyia seneciella* (Meade) (Diptera, Muscidae) for Shipment to Australia. *N.Z. J. Sci. 1*:417–422. J. M. Hoy.

Damage by Clover Case-bearer Caterpillars. Ibid. *1*:525–526. J. M. Kelsey.

Damage in Ryegrasses by *Hyperodes griseus* Hust. *N.Z. J. agric. Res. 1*: 790–795. J. M. Kelsey.

Damage to Wheat by Grass Grubs and Subterranean Grass Caterpillars. In *N.Z. Wheat Review No. 7*:49–51. J. M. Kelsey.

Symbiosis and *Anobium punctatum* De Geer. *Proc. roy. ent. Soc. Lond. (A) 33*:21–24. J. M. Kelsey.

Control of *Pieris rapae* by Granulosis Viruses. *N.Z. J. agric. Res. 1*: 778–782. J. M. Kelsey.

A note on two Diseases Attacking *Persectania aversa* (Walk.) in the Field. *N.Z. Ent. 2 (2)*:30. A. D. Lowe.

The Development of an Electronic Aphid-Counter. *N.Z. J. agric. Res. 1*: 903–912. A. D. Lowe and W. V. Dromgoole.

Insect Pests of Brassicas. *Proc. 8th Lincoln College Farmers Conf.*: 111–120. A. D. Lowe.

A Review of Work in New Zealand on the Clover Case-bearers *Coleophora spissicornis* Haw. and *C. alcyonipennella?* Kollar (Coleophoridae, Lep.). *N.Z. J. agric. Res. 1*:239–248. A. M. Stuart.

Incidence and Parasitism of Insect Pests of Cruciferous Crops in Hawke's Bay, Wairarapa, Manawatu, Rangitikei, and Taranaki, 1956–57. Ibid. *1*:847–858. D. H. Todd.

A Strong Flight of *Charagia virescens* (Dbld.). *N.Z. Ent. 2 (2)*:14. J. I. Townsend.

FATS RESEARCH LABORATORY

Director: Dr F. B. Shorland

PROJECTS

General Investigations on Animal Fats with Special Reference to those of Meat and Butter—Isolation and identification of minor constituents including branched-chain fatty acids, *n*-odd numbered carbon fatty acids and unsaturated fatty acids; glyceride structure; variations in the fatty acid composition of animal fats in different tissues and at different stages of growth; and changes in carcase composition in respect of fat, crude protein, and water as influenced by age and diet.

Fat Metabolism in Ruminants—The effect of the rumen on dietary unsaturated fatty acids; the relationship between the dietary and depot fats of ruminants; the use of labelled intermediates to determine the origin of *n*-odd numbered and branched-chain fatty acids in milk and depot fats of ruminants; and the *trans*-unsaturated acid contents of liver and faecal lipids.

Nutritional Significance and Fate of Minor Constituents of Dietary Animal Fats—Aspects of this general problem being studied in association with the Nutrition Research Department of the Medical Research Council include: (a) relationship between certain lipid constituents such as branched-chain fatty acids, cholesterol deposition, and atherosclerosis, and (b) fate of branched-chain fatty acids in the body.

Nature of Phospholipids in Animal Products—The preparation of pure phospholipid fractions from meat and milk products to determine their composition and their role in the keeping properties and quality of these products.

Rancidity in Animal Fats—Nature of the compounds responsible for the Kreis and thiobarbituric acid tests used to detect incipient rancidity.

Industrial Utilisation of Fats and Fatty Oils—The composition of tall oil from the New Zealand paper industry with a view to its utilisation; modification of the properties of animal fats to widen their usage; development of methods for the synthesis of triglycerides of known constitution; and the synthesis of emulsifying agents such as monoglycerides and plastic fatty coatings from acetoglycerides.

Development of New Techniques for the Investigation of Fats—The application of gas-liquid partition chromatography to the study of fatty acid composition using improved methods for detection and estimation; and simplified methods for the preparation of methyl esters.

Investigations on the Composition of Pasture Lipids and the Lipids of Associated Micro-organisms—The composition of the chloroplast lipids of red clover are being investigated as part of the major project on bloat being carried out by the Plant Chemistry Division at Palmerston North. In addition the lipids of micro-organisms including those of *Sporidesmium bakeri* found associated with pasture and of possible significance in relation to facial eczema are being investigated.

PUBLICATIONS

Occurrence of *trans*-unsaturated Acids in the Faecal Lipids of Ruminants and Non-ruminants. *Biochem. J.* *69*:1–5. L. Hartman, F. B. Shorland and B. Cleverley.

Advances in the Synthesis of Glycerides of Fatty Acids. *Chem. Revs. 58*: 845–867.

Some Technical Aspects of Rice Bran Oil Recovery. *J. Burma Science Assoc. 3*:26–30. Daw Kyin Yi and L. Hartman.

Direct Conversion of Soaps into Methyl Esters. *J. Amer. Oil Chemists' Soc. 34*:165. L. Hartman.

Trace Constituents of Hydrogenated Ox Perinephric Fat. *J. Sci. Food and Agric. 8*:391–396. R. P. Hansen, F. B. Shorland and N. J. Cooke.

Tall Oil: Isolation of the Branched-chain Fatty Acid (+)-14-methylhexadecanoil Acid and of the Straight-chain Acid Palmitic Acid. Ibid. *8*:482–485. R. P. Hansen and N. J. Cooke.

Seasonal Changes in the Fatty Acid Composition of Ewe-milk Fat. *Biochem. J. 68*:644–646. T. Gerson, F. B. Shorland and C. R. Barnicoat.

Recent Work on Animal Fats. *N.Z. Soc. Animal Prod. 18*:99–110. F. B. Shorland.

The Work of the Fats Research Laboratory, *Tuatara 7*:6–7. F. B. Shorland.

The Occurrence of α-picoline in Plants. *Nature 182*:1734. R. E. R. Grimmett and F. B. Shorland.

FRUIT RESEARCH DIVISION

Director: Mr J. D. Atkinson

PROJECTS

Variety Testing—Trials include some 700 imported apple varieties, small blocks of promising local seedlings of peach, plum, feijoa, and Chinese gooseberry, and a small number of imported apricots, citrus, peaches, and subtropical fruit.

Rootstock Testing—Long-term trials of selected apple stocks worked with five scion varieties; plum stocks budded with three varieties; citrus stocks worked with four varieties; and pear stocks budded with one variety. A search for *Phytophthora* resistance in apple stocks is continuing.

Citrus Breeding—Objectives are the production of improved lemons and citrus hybrids suitable for local conditions.

Strawberry Breeding—The objective is to breed resistance to virus and root rot into a strawberry with the desirable characteristics of the Captain Cook variety.

Fruit Descriptions—Formal description and classification of apples and Japanese plums peculiar to New Zealand.

Determination of Fertiliser Requirements of Fruit Trees—Field fertiliser trials, and use of leaf analyses.

Orchard Management—Use of grass and clover mixtures as opposed to clean cultivation.

Application of Hormones in the Orchard—Use of hormones for increasing fruit set, prevention of fruit drop, and thinning of various fruits. Control of biennial bearing.

Storage of Apples and Pears—Control of superficial scald, controlled atmosphere storage of New Zealand apple varieties, and freezing points of pears.

Tree Physiology—Elements present in tree xylem sap, mechanism of phloem transport, and natural hormones present in vegetative shoots.

Tree Nutrition—Entry of nutrients applied to leaves. Metabolism of urea and phosphate by leaves.

Development of Apple Fruit—Changes in the natural hormone content of developing fruits. Accumulating ability of cells of young fruit.

Measurement of Cell Size—Application of haemocytometer, sedimentation, and other techniques to hasten measurement and counting of cell populations.

Storage Quality of Fruits—Analysis of effects of orchard nutrition and chemical thinning on storage quality of apples.

Tissue Culture—Requirements of apple fruit tissue in culture.

PUBLICATIONS

Apple Rubbery Wood in N.Z. *Orchardist of N.Z. 32*:2–3. 1959. J. D. Atkinson, E. E. Chamberlain, and J. A. Hunter.

Certification of Therapeutants and Plant Hormones, 1958 ed. *N.Z. Dep. sci. industr. Res., Inf. Ser. 13*:1958. E. E. Chamberlain and J. D. Atkinson.

Fruit Research Division: Review of Work in Progress. *N.Z. Sci. Rev. 16*:67–70. 1958. J. D. Atkinson.

Two Diseases of Plum Causing Distortion and Internal Necrosis of Fruits. *N.Z. J. agric. Res. 2*:174–183. 1959. E. E. Chamberlain, J. D. Atkinson, and J. A. Hunter.

Virus Can Spread through Root Grafts. *Orchardist of N.Z. 31*:150. 1958. J. D. Atkinson.

The Physiology of Sugar Cane. II – The Respiration of Harvested Sugar Cane. *Aust. J. Biol. Scs. 11*:315–328. 1958. R. L. Bieleski.

Nitrogenous Compounds in Tree Xylem Sap. *IN* The Physiology of Forest Trees; a Symposium Held at the Harvard Forest, April, 1957, under the Auspices of the Maria Moors Cabot Foundation; edited by Kenneth V. Thimann. New York, Ronald press, 1958. E. G. Bollard.

2, 4, 5-T Hastens Maturity of Oullins and Moorpark Apricots. *Orchardist of N.Z. 31*:275, 277, 279. 1958. A. Farmer, J. E. Hawkins, and G. E. Roberts.

Dwarf Peach Trees: their History and Development. *N.Z. Gardener 15*: 363–367. 1959. A. Farmer.

Cultivation of Apple-fruit Tissue *in vitro*. *Nature 182*:473-474. 1958. D. S. Letham.

Apple Rootstocks in N.Z. Orchards. *Orchardist of N.Z. 31*:294–297. 1958. H. M. Mouat and D. W. McKenzie.

N.Z. Varieties of Yang-tao or Chinese Gooseberry. *N.Z. J. agric. 97*: 161–163. 1958; *Orchardist of N.Z. 31*:135–137. 1958. H. M. Mouat.

Cold Storage of Hawke's Bay Peaches. *Orchardist of N.Z. 31*:299. 1958. C. S. Padfield.

Cold Storage of Hawke's Bay Plums. *Orchardist of N.Z. 31*:347, 349. 1958. C. S. Padfield.

Progressive Reduction of Storage Temperature for Apples. *N.Z. J. agric. Res. 1*:165–168. 1958. C. S. Padfield.

Superficial Scald: Some Methods of Control, Reported Overseas, Applied to N.Z.-grown Granny Smith Apples. *N.Z. J. agric. Res. 1*: 231–238. 1958. C. S. Padfield.

GEOPHYSICS DIVISION

Director: Dr E. I. Robertson

PROJECTS

Magnetic Survey—Continuous recording and analysis of the earth's magnetic field at Apia, Amberley, Scott Base, and Hallett Station; study of secular variation for preparation of magnetic charts for navigation purposes; relationship of earth current and magnetic effects; and upper atmospheric disturbances produced by the Johnston Island high altitude nuclear explosions.

Geophysical Observatory—Continuous recording and analysis of ionospheric conditions at Rarotonga, Christchurch, Campbell Island, Hallett Station, and Scott Base; relationship between true and virtual ionospheric heights; theory of layer formation; analysis of occurrence of sporadic E at all stations; normal and ionospheric storm conditions at low, temperate, and high latitudes; radio propagation conditions in New Zealand; Chapman behaviour in lower E region; anomalous behaviour of F 1 region at low and high latitudes; development of equipment for measuring peak E region echo amplitudes in connection with absorption of radio waves in the lower ionosphere; and ionospheric effects of the high altitude nuclear explosions at Johnston Island. Continuous recording and analysis of the hard component of cosmic radiation at Christchurch; and meson telescope investigations at Invercargill and Christchurch.

Seismological Observatory—Continuous recording and analysis of earthquake data at New Zealand, Antarctic, and Pacific Island stations; maintenance of New Zealand time service; IGY longitude-latitude project at Wellington; seismicity and crustal structure of New Zealand and Antarctica; seismic travel times in the New Zealand region; atomic bomb recordings in the New Zealand area; and analysis of ScS amplitudes at Wellington.

Geophysical Survey—Crustal structure of New Zealand; gravity surveys in New Zealand and Antarctica; bridge foundation investigations for Ministry of Works; paleomagnetism; analysis of Scott Base and Hallet Station seismograph, auroral, solar radiation, and tide gauge data; and theory of the growth of continents.

Volcanological investigations at the Chateau; Wairakei heat flow and heat storage; two-phase flow in boreholes; and heat flow and other investigations at Waiotapu and Orakei-Korako.

PUBLICATIONS

Geophysical Reconnaissance at Kawerau, New Zealand. *N.Z. J. Geol. Geophys.* *1*:219–246. F. E. Studt.

Temperature Distribution about a Cooling Volcanic Intrusion. Ibid. *1*:364–374. W. I. Reilly.

Some Observations on Night-time Ionospheric Storms at Christchurch. Ibid. *1*:519–529. R. F. Mason.

Bouguer Anomaly Map of New Zealand. Ibid. *1*:560–564. E. I. Robertson and W. I. Reilly.

Wairakei Hydrothermal Field under Exploitation. Ibid. *1*:703–723. F. E. Studt.

A Survey of the Tektite Problem. Ibid. *2*:183–194. G. A. Eiby.
The Pulsed Vibrator as a Seismic Source. *Geophysical Prospecting 5*: 381–391. F. F. Evison.
Antarctic Research. *Nature 182*: 285–289. T. Hatherton.
Thickness of the Earth's Crust in Antarctica. Ibid. *183*:306–308. F. F. Evison.
Man-made or Artificial Aurora. Ibid. *182*:1365–1366. A. L. Cullington.
Large Telescopes. *Southern Stars 17*:106–111. G. A. Eiby.
This Earth of Ours (Part 1). *Post-primary School Bull. 11, 9*:36. G. A. Eiby.
This Earth of Ours (Part 2). Ibid. *11, 10*:35. G. A. Eiby.
Magnetic Data: Apia 1953, 1954; Amberley 1955.
Ionospheric Data: Godley Head 1956; Rarotonga 1956; Campbell Island 1955, 1956.

GRASSLANDS DIVISION

Director: Dr P. D. Sears

PROJECTS

Plant Physiology—The influence of different levels of temperature and light on the growth of pasture species, and on the proportion of plant tissue constituents under controlled environment; the effects of nitrogen, temperature, and soil moisture levels on summer survival of ryegrass strains; photoperiodic effects on flowering of white clover and other species; the production under controlled conditions of rapid growth of grass, together with the fungus associated with facial eczema; the establishment of a series of microclimate stations throughout New Zealand; and seasonal changes in tiller numbers of various species in unit pasture areas throughout the country.

Plant Breeding and Genetics—Maintenance and improvement of the following species and strains; perennial ryegrass, Italian ryegrass, H.1 ryegrass, cocksfoot, timothy, white clover, broad red clover (cowgrass), Montgomery red clover, *Lotus uliginosus, Lotus corniculatus,* zigzag clover, H.1 by perennial ryegrass hybrids, tall fescue, and hybrids with perennial ryegrass. Improved strains of the first eight of the above species have already been released and are under Government certification, but further improvement work is being carried out on them as well as on those not yet released. In addition, single plant and sward comparisons are under way of several other species and strains, particularly of strawberry clover, subterranean clover, and meadow fescue. Other projects are: the production of a white clover strain that breeds true for an easily identifiable leaf marking; the production genetics of ryegrass; the production and study of polyploids in red clover and *Lotus*; examination of certain Spanish strains of white clover for their winter growth potential and their ability to fix nitrogen in the winter and, by crossing with selected New Zealand strains, to incorporate these attributes into the present pedigree New Zealand strains; study of the compatability of different species and strains of pasture plants, with the growth of certain fungi, particularly *Sporidesmium bakeri*; in collaboration with Plant Chemistry Division and Fats Research Laboratory, the testing of plant extracts for toxicity to various micro-organisms; and improvement in techniques for the certification of bred strains.

Soil Fertility—Survey of build-up of organic matter and organically bound nutrients in major North Island soil types under pasture; differential uptake of nutrients by pasture plants and the mechanisms involved; sulphur nutrition of red and white clovers; major and minor element effects on establishment of clovers on Wharekohe silt loam, a Northland "gumland" soil; rate of increase of soil fertility under different pasture systems, and the rate of decrease under cropping; and effects of nitrogen and mineral fertilisers on pasture yield and composition.

Pasture Ecology—Seed dormancy of pasture grasses; buried seed populations of weeds and pasture species; seedling growth under different environments; time of change to and the period of flowering of different pasture grasses; pasture establishment and pasture mixtures; effects of grass-grub and other insects on pasture productivity; effects of grazing intensity on seasonal production, and relationships with leaf area and total light interception; effects of sheep treading on pasture and soil; use of chemical weedkillers and soil fumigants; pasture management on a farmlet basis on both lowland and hill country, also in relation to soil conservation and animal thrift; collaboration with Plant Chemistry Division on hogget ill-thrift trials; development of pastures on Northland "gumland" soils; soil-pasture-animal cycle of production; and collaborative trials with Crop Research Division on new potato and wheat varieties grown on high fertility soil at Palmerston North.

PUBLICATIONS

Effects of Differences of Light Intensity and Temperature on the Anatomy and Development of Leaves of *Lolium perenne* and *Paspalum dilatatum*. *N.Z. J. agric. Res. 1*:1–16. K. J. Mitchell and Kathleen Soper.

The Light Regime within Pastures. Ibid. *1*:61–68. K. J. Mitchell and D. M. Calder.

Genetic and Environmental Components of the Productivity of Ryegrass. Ibid. *1*:86–103. S. O. Fejer.

Interception of Light by the Foliage of Pure and Mixed Stands of Pasture Plants. *Aust. J. agric. Res. 9*:39–52. R. W. Brougham.

Some Effects of Treading on Pasture. *Proc. 18th Conf. N.Z. Anim. Prod. Soc.*: 43–49. D. B. Edmond.

Some Effects of MCPB on Establishing Pastures. *N.Z. J. agric. Res. 1*: 281–89. D. B. Edmond.

The Tiller Population of Pastures. Ibid. *1*:305–18. K. J. Mitchell and A. C. Glenday.

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The Influence of Treading on Pasture. Ibid. *1*:319–28. D. B. Edmond.

Animal Treading and Pastures. *Agric. Rev. 4*:8–15. D. B. Edmond.

The Effect of Light and Temperature on the Chemical Composition of Pasture Plants. *N.Z. J. agric. Res. 1*:540–52. N. O. Bathurst and K. J. Mitchell.

Persistence of Weed Seeds. *M.A.C. Dairyfmg. annu. 1958*:148–52. E. O. C. Hyde.

Investigations at Grasslands Division. *M.A.C. Sheepfmg. annu. 1958*: P. D. Sears.

Some Effects of Soil Physical Conditions on Ryegrass Growth. *N.Z. J. agric. Res. 1*:652–59. D. B. Edmond.

Some Long-term Effects of Fertilisers on a Mown Turf of Browntop and Chewings Fescue. Ibid. *1*:665–74. D. B. Edmond.

Leaf Development in Swards of White Clover. Ibid. *1*: 707–18. R. W. Brougham.

Loss of Moisture from Vegetation. *Nature 181*:1619–20. K. J. Mitchell and R. L. Closs.

The Effects of Topdressing and Oversowing Hill Pastures. *N.Z. J. agric. Res. 2*:153–64. F. E. T. Suckling.

Intraspecific Competition as a Factor in Ryegrass Breeding. Ibid. *2*: 107–23. S. O. Fejer.

HOP RESEARCH STATION

Superintendent: Dr R. H. J. Roborgh

PROJECTS

Breeding—The study of botanical characters to aid differentiation of hop varieties; the introduction and evaluation of hop varieties from overseas; the breeding of new hop varieties tolerant to root rot (*Phytophthora* sp.); the germination of hop seed; the technique of testing for susceptibility to root rot at the seeding stage; the technique of rapid propagation of promising seedlings; and the raising of polyploids.

Agricultural Ecology—The study of the influence of method of planting; quality and treatment of the planting material; effect of the method of growing and climatic conditions on the development of the hop plant; and the effects of manuring, particularly as regards influence on the occurrence of root rot.

INFORMATION BUREAU

Officer in Charge: Mr N. A. Marris

FUNCTIONS AND PROJECTS

The functions of the Information Bureau include the editing and publishing of three scientific journals and of other departmental publications, the provision of a central library service (including reference facilities, cataloguing, inter-library lending, book ordering, and assistance to branch libraries), and the maintenance of a technical information section, a publicity section, a photographic section, and a photocopy service. In addition, a *D.S.I.R. Newsletter* is issued each month for staff information, and certain translation work is undertaken.

PUBLICATIONS

The *New Zealand Journal of Agricultural Research* is published in alternate months; the *New Zealand Journal of Geology and Geophysics* and the *New Zealand Journal of Science* are published quarterly.

The Bureau has also, during the year, edited and published 26 bulletins and other publications on behalf of the Department and its branches.

Publications by Officers in Head Office comprise:

White Island. *N.Z. Dep. sci. industr. Res. Bull. 127.* Compiled by W. H. Hamilton and I. L. Baumgart.

Bibliography of New Zealand Tussock Grasslands. *N.Z. Dep. sci. industr. Res. Bull. 132.* Helen M. Drummond and E. H. Leatham.

NEW ZEALAND GEOLOGICAL SURVEY

Director: Mr R. W. Willett

REGIONAL PROJECTS

Geological—The preparation of the text of regional bulletins is complete for Morley and Te Aute subdivisions. Field work continues in the Hokonui subdivision and the preparation of text is under way for Papatowai subdivision. The four-mile project has made inroads on field work in the Fairlie and Pareora subdivisions. A summer's field work was carried out in the McMurdo Sound region where some detailed aspects of Antarctic geology were examined. The text for the Hallett Bay geological bulletin is complete, apart from some petrological descriptions.

Paleontological—Work on the project Mesozoic belemnites at the Sedgwick Museum has now been completed and is being prepared for publication. Research work on Jurassic fossils continues. The manuscript for a paleontological bulletin on the Foraminifera of the Oamaru area is nearing completion, and the paleontological collections of certain regional areas, such as Tuatapere, are being studied. The four-mile mapping project calls for continuous examination of field collections by both macro- and micro-paleontological sections. Correlation of Cretaceous and Tertiary marine and non-marine rocks by means of fossil pollen grains and spores has been refined, and a bulletin text prepared. Similar work continues in the Pleistocene.

Petrological—Chatham Islands petrological studies are completed. Regional study of the volcanic rocks of the North Island has been commenced. Petrology of rocks from the Waikato coalfield for bulletin purposes has been completed.

Coal—Systematic study of New Zealand coalfields has been completed and the completion of the text of the Waikato coalfields bulletin will terminate the regional work of the original coal survey.

Four-mile Project—The four-mile project is now taking an increasing share of the Survey's time, and has begun to show positive results. Sheet No. 10 (Wanganui) has been published, and field work and text of No. 21 (Christchurch) and No. 27 (Fiord) completed. Field work and compilation have been completed for sheets No. 2B (Barrier), 4 (Hamilton), 11 (Dannevirke), and 24 (Invercargill). Field work and compilation is proceeding in sheet No. 8 (Taupo), 12 (Wellington), 13 (Golden Bay), 15 (Buller), 16 (Kaikoura), and 22 (Wakatipu).

One-mile Project—A further one-mile sheet (N85, Waiotapu) has been completed, while compilation of N76 and N77 has been completed.

SPECIAL PROJECTS

Phosphate Research—This joint effort with the Bureau of Mineral Resources, Geology and Geophysics, Canberra, continues but with practically no activity during the year. Results of work so far in the outlying islands of New Zealand have proved negative. Further work is proposed in the Southern Cook Group and Tonga Islands.

Paleontology—Study of the fossils of the Otaian Stage continues. Special study is being made of the genus *Rzehokina* of the Upper Cretaceous and is approaching completion. Stratigraphy of the Jurassic section at Kawhia is now completed for publication. Following work on New Zealand Tertiary corals published in the previous year by an American expert, Dr Donald Squires, research has been recently recommenced on this project at the Geological Survey by Dr Squires, here on a Fulbright fellowship. Assistance to oil search group micropaleontologists still forms a part of the routine work. Work on Permian invertebrates is being prepared for publication and expanded by field work in New Zealand type localities.

Petrology—Studies in field and laboratory of the mineralisation of north-west Nelson have been recommenced during the year. The regional study of ignimbrites is making progress.

Quaternary Tectonics—This project still occupies our attention because of the wealth of material that New Zealand offers. Several papers have been published on the subject and the Quaternary tectonics project of the eastern part of the North Island is well under way. Again the generous assistance of the Civil Aviation Administration of the Air Department has been particularly valuable in obtaining special photographs of these features.

Glaciology—The work initiated by Professor R. P. Goldthwait last year has been continued as an IGY project with some positive results in both Tasman and Franz Josef glaciers. A limited amount of work has also been carried out on the glaciers of Ruapehu.

Pleistocene History—Mapping of Pleistocene deposits in North and South Islands continues to occupy field geologists' attention, especially in conjunction with the four-mile project. A senior officer who spent a year studying Pleistocene research overseas has now returned, and this project should show resulting benefit. Detailed description of type ash shower sections in the volcanic area has been completed.

Geological Map in New Zealand—The geological map of New Zealand on a scale of 1:2,000,000 has been printed and notes enlarging upon the legend, in the form of a bulletin, have been forwarded to the editor. Once this and the explanatory note for secondary schools have been printed, the 1:2,000,000 project will be completed.

INDUSTRIAL AND ROUTINE PROJECTS

Radioactive Minerals—Decreasing interest in radioactive minerals overseas, resulting from oversupply, has been reflected in the search in New Zealand. The geology of the Hawks Crag breccia in the Lower Buller Gorge has been published, and further work is dependent upon prospecting activities. The Bullock Creek area originally mapped by the Geological Survey has now been actively prospected.

Foundation Projects—Dam site investigations still rank among the most important aspects of applied geology, the principal areas of work

being Rangitaiki River, Whakatane River, Motu River, and Tongariro area in the North Island, while Benmore on the Waitaki River is the main project under investigation in the South Island.

Coal Mines—Day to day advice and consultations continue, particularly in the Greymouth and Waikato fields.

Groundwater—Frequent calls for advice in the search for groundwater occupy the attention of the Survey, but with increasing geological knowledge arising from the four-mile project, many of these queries can be answered without going into the field. Regional study of groundwater in the Waikato Basin has been completed and the bulletin text is ready.

Geothermal—Geological work on the geothermal area has been largely petrological, where examination of bore cores and hydrothermal alteration continues to yield information of importance to the project. Regional geology has been completed in the Wairakei and Wāiotapu areas and the need is now for subsurface, rather than surface information.

Miscellaneous Minerals—Miscellaneous metallic and non-metallic minerals have been identified and commented on throughout the year. A few involved field work.

Geology for Schools—The preparation of selected groups of typical New Zealand rocks has resulted in an increasing number of schools seeking such a set. An increasing number of calls are made upon the Information Officer for brief talks on geology to secondary schools.

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NEW ZEALAND OCEANOGRAPHIC INSTITUTE

Director: Mr J. W. Brodie

PROJECTS

Physical Oceanography

Hydrology—Analysis of the survey of circulation, temperature, and salinity of coastal waters is completed and in press; results of the investigation of surface drifts are being prepared for publication. Further detail of surface water temperatures and salinities off the west coast of

both islands has been obtained with the generous assistance of shipping companies. Field work on sub-Antarctic and subtropical circulation systems was continued. Further bulk samples of water from depth for measurement of ^{14}C activity were obtained over a wide range of latitude as part of the study of deep currents.

Work on seasonal fluctuations of sea level is continuing. Interpretations of the properties of waves generated over short fetches were concluded and published.

Marine Biology

Plankton—Initial field work on microdistribution of plankton and its relation to the physical properties of water has been completed and results of analysis are being prepared for publication. Sampling to determine the seasonal occurrence of phytoplankton has been concluded. Preliminary work on the ecological aspects of bacteriology continues. The study of micro-organisms was extended by the work of Dr R. E. Norris, under a Fulbright award, on occurrence and nutritional requirements of diatoms and flagellates.

Benthic Faunas—Identification of material collected and studies of its distribution, continue for the survey of Hawke Bay bottom-living animals. A similar survey has been commenced in Cook Strait. Further contributions have been made to the systematics of the amphipoda and further materials acquired towards compilation of a bibliography of the group.

Marine Geology

Sedimentation—Analysis of the shallow-water cores obtained in the Hawke Bay sediment survey is nearing completion and is providing data on the late sedimentary history of the area. A description of the structure and sediments of the east coast North Island shelf and slope is in preparation.

Detailed analysis of calcareous oceanic sediment cores has continued as part of the study of the late-Pleistocene marine environment.

Antarctic Activities

A regional survey of the plankton, bottom fauna, hydrology, and sediments of the Ross Sea has been carried out this season. Field work on the geographical position and nature of the Antarctic convergence was continued, part in cooperation with the Oceanographic Branch of the United States Navy Hydrographic Office. The bulk of this work was able to be undertaken only by reason of the generous assistance of the Royal New Zealand Navy in providing ships and time at sea.

SPECIAL PROJECTS

Cook Strait Cable Investigations—Measurements of bottom and surface currents have been made in Cook Strait to assist the New Zealand Electricity Department. Similarly a detailed analysis of sediment distribution in the Cook Strait narrows has been carried out and experiments made with the movement of artificial tracer sediment placed on the sea floor.

Wave Measurements—The picture of wave climate at Lyttelton Harbour was extended by the continued operation of a wave recorder.

Marine Fouling—Examination of the extensive survey of marine fouling at the main ports, the field work for which was concluded earlier has now also been completed. Most of the results have now been published, the balance is in preparation.

Hawke Bay Surveys—The sediment and faunal surveys in Hawke Bay have been combined as a cooperative undertaking with Marine Department studies of the food requirements of the tarakihi.

Facilities

As with Antarctic operations, the whole of the oceanic sea-going facilities have been generously provided by Navy Department principally by provision of RNZFA *Tui* for research cruises of a similar nature to those of the previous two years. The Marine Department has also given valuable assistance with vessels.

PUBLICATIONS

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PLANT CHEMISTRY DIVISION

Director: Dr A. T. Johns

PROJECTS

Bloat—The investigation of the animal and plant factors involved is being undertaken, e.g., composition of bovine saliva, bacterial polysaccharides and nutrition of protozoa, release of soluble constituents from plant material, eructation mechanism in cattle, foaming properties of plant proteins and saponins, anti-foaming properties of plant fats, and plant carbohydrates and their fermentation products in the rumen.

Pasture Plant Biochemistry and Organic Chemistry—A number of biochemical processes in plants and particular compounds are being investigated, either for their interest in plant biochemistry or from their role in animal nutrition, e.g., assimilation of urea by plants, biosynthesis of cyanide-containing glucoside, structure of perloline, identification of antifungal substances in red clover, and determination of level of keto acids in plants.

Proteins—The isolation and characterisation of plant nucleoproteins is being undertaken, together with a study of bovine salivary mucoprotein. In conjunction with Plant Diseases Division a study is being made of the physical properties of turnip yellow mosaic and clover viruses.

Non-protein Nitrogen—Analysis of pasture has demonstrated that "ill-thrift" herbage contains a considerable amount of inorganic nitrate together with an easily oxidised organic nitrogenous substance(s) which is not present in other herbage. Work in collaboration with Dominion Laboratory is in progress to identify the unknown organic nitro compounds. Work on plant peptides is also in progress.

Facial Eczema—The large scale extraction of toxin from facial eczema grass is being carried out for Ruakura Animal Research Station. A study of the "beaker test" substance from *Sporidesmium bakeri* is being made.

Microbiological Work—The isolation and culture of rumen bacteria and protozoa and a study of their nutrition and metabolism.

The role of CO_2 in the metabolism of *Streptococcus bovis* is being studied with the aid of radioactive carbon.

Investigation of patterns of effectiveness of clover and of strains of clover rhizobia is being undertaken, together with the estimation of numbers of rhizobia present in various soils. A comparison is being made between single inoculated plants of red and white clover as regards their nitrogen fixing ability. The treatment necessary for good clover growth at Kaikohe substation is being investigated.

Carbohydrate Chemistry—Investigation of the carbohydrate composition of clovers and grasses, particularly polysaccharides and sugars in relation to bloat.

Lipids—Studies on the composition of chloroplast fat and its metabolism in the rumen are being made in conjunction with Fats Research Laboratory.

Iodine Nutrition of Sheep—The iodine nutrition of sheep as affected by possible goiterogenic principles in white clover and low iodine status of some grass species is being studied in conjunction with the sheep husbandry department of Massey College.

Mineral Nutrition—Mineral analyses of plant material, rumen saliva, and bovine saliva are being carried out. Differences in the ability of strains of pasture plants to accumulate minerals is being investigated in conjunction with the Grasslands Division.

Ruminant Physiology—The study of the mechanical activity of reticulum and rumen; the eructation process; the pathogenesis, treatment and prophylaxis of bloat with anti-foaming agents; analysis of the food bolus; and salivary secretion in relation to feeding.

PUBLICATIONS

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Study of Physiology and Biochemistry of Pasture Plants Extends to Conversion of Food in Ruminant's Stomach. *N.Z. Young Farmer 11*:67. A. T. Johns.

PLANT DISEASES DIVISION

Director: Dr E. E. Chamberlain

PROJECTS

Entomology—General: Investigation of aphid resistance in brassica field crops; ecological study of *Brevicoryne brassicae* in Canterbury (with Entomology Division); investigation of San Jose scale; and systematic studies of Acarina, Orthoptera, Coleoptera and Trichoptera.

Insecticides: Control of existing infestations of *Anobium punctatum;* hormonal evocation of moulting and excretion in *Rhodnius prolixus;* and ionic balance following DDT poisoning in *Rhodnius prolixus.*

Economic Mycology—Studies on physiological races of and varietal resistance to French-bean rust, tomato leaf mould, and verticillium wilt (cooperative projects with Crop Research Division); determination of host range of verticillium wilt and its control in the soil with fungicides; studies on prevention of silver leaf infection by overall sprays to protect newly made pruning cuts; field tests on control of big vein of lettuce with fungicides applied to the soil; therapeutant control of lettuce ring spot; control of apple collar rot by application of fungicides to the

soil and testing apple rootstocks for resistance; investigation of gummosis disease of apricots; and control of Didymella on tomatoes by spray applications (in cooperation with Horticulture Division, Department of Agriculture).

Investigations on death of pine trees: association of *Phytophthora* species in the soil with pine tree death; identification and distribution of *Phytophthora* species in forest and shelterbelt soils; and testing pathogenicity of species isolated.

Field crop diseases: Field survey of wheat diseases in Canterbury Province (in conjunction with Crop Research Division); control of potato pink rot with fungicides applied to the soil; life history studies of the fungus causing dry rot of brassicas; control of dry rot and club root of brassicas with fungicides; studies on the economic importance and overwintering of turnip mosaic and cauliflower mosaic on brassica crops and cereal yellow dwarf on cereals and grasses; selecting and testing of varieties for resistance to cereal yellow dwarf in wheat and oats, eye spot in wheat, Fusarium wilt in peas, Mycosphaerella stem canker in lupins, and dry rot in swedes; control of celery leaf spot with fungicides (in cooperation with Horticulture Division, Department of Agriculture); studies on motley dwarf virus of carrot; control of cauliflower mosaic virus and cereal yellow dwarf by spraying of crops with insecticides to control vectors; and studies in maize stalk rot.

Seed Pathology: Relative importance of seed vigour, soil conditions and seed dusts on establishment of wheat crops; control of seed borne dry rot of brassicas by seed treatment; control of white rot of onions by pelleting of seeds with fungicides; investigation of role of seed transmission in spread of Didymella stem rot of tomato; and investigation of poor germination of pea seed.

Identification and recording fungi responsible for plant diseases; and maintenance of a list of all plant diseases recorded in New Zealand.

Systematic Mycology—Collection and identification of New Zealand fungi for herbarium; classification and life history studies of New Zealand Pyrenomycetes belonging to the genera *Nectria, Hypocrea, Gibberella,* and *Hypomyces* in the Hypocreaceae; *Hypoxylon* and *Rosellinia* in the Sphaeriaceae; taxonomic studies of *Sporidesmium bakeri* and selection of strains suitable for toxin production; taxonomy of Streptomycetes from New Zealand soils; and description of further species of *Uredinales* and *Ustilaginales* occurring in New Zealand.

Bacteriology and Microbiology—Taxonomic studies of the genus *Xanthomonas;* control of bacterial spot of plum and peach; investigations on protection of seedlings and cuttings from crown gall; identification and infection studies with bacterial blight of mulberry, bacterial leaf spot of cauliflowers, and Delphinium leaf spot; and maintenance of stock collection of all plant pathogenic bacteria.

Maintenance of certification scheme for legume seed inoculants; serological typing of *Rhizobium* strains; search for improved strains; investigations of methods of retaining viability of legume cultures on seeds by use of stickers, seed pelleting, etc.; and maintenance of tested *Rhizobium* strains and supply of experimental cultures.

Physiological studies on *Sporidesmium bakeri,* the fungus responsible for the facial eczema disease of sheep; investigation of methods for mass production of spores of *S. bakeri* to supply material for toxicity testing and characterisation of the toxin. Study of the biology of the

fungus with a view to field control. Occurrence of actinomycetes on pasture plants; and antagonistic properties of the Streptomycetes in New Zealand soils.

Virus Diseases—In cooperation with Fruit Research Division, identification of virus diseases of pome and stone fruit trees; effect of fruit tree viruses on tree growth, yield and rootstock scion compatibility; use of cross protection in testing of trees for virus freedom and protecting trees in the orchard; indexing of budwood trees; and elimination of fruit tree viruses by heat treatment.

Investigation of rough bark of Oriental flowering cherry; studies on virus diseases of roses; investigation of a widespread mosaic disease of clovers and the chemical and physical characterisation of the virus; studies on field resistance of turnip and swede varieties to turnip mosaic and cauliflower mosaic; identification of virus diseases occurring on tobacco; studies on seed transmission of tobacco mosaic on tomato; and studies on the early stages of infection with tobacco mosaic virus.

Changes in RNA content of tobacco leaves during infection with tobacco mosaic virus; studies on the structure and multiplication of tobacco mosaic and turnip yellow mosaic viruses; chemotherapy of plant viruses; serological reactions of plant viruses, particularly those of turnip mosaic and cauliflower mosaic; and studies on the ribonucleic acids of the subcellular particles of plant tissues.

Plant Physiology—Investigations into the role of humidity, shading, temperature, and tobacco mosaic infection in the development of blotchy ripening of tomatoes grown under commercial glasshouse conditions.

Plant Therapeutants—Maintenance of a system of certification of plant therapeutants, the chemical control of insect pests and fungous diseases, e.g., study of environmental factors upon the activity of chemicals used against egg and juvenile forms of red spider mites: persistence of systemic insecticides in apple against mites and in brassicas against aphids; field control of red spider mites on apple with systemic and residual acaracides; comparison of insecticides against codling moth; timing of application against onion thrips and the corn ear worm; investigation of control measures against San Jose scale.

Field comparison of fungicides against apple black rot (Glomerella), apple black spot, stock downy mildew, onion downy mildew, Verrucosis on citrus, bunt of wheat, powdery mildew of rose, cucurbit and apple; and comparison between glasshouse and field performance of a group of brands of copper oxychloride against late blight of potatoes and tomatoes.

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Biosynthetic Incorporation of Metabolite Analogues. *Pharmacol. Revs. 10*:359–406. 1958. R. E. F. Matthews.

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Field Crop Diseases Thrive on Residues. *N.Z. Young Farmer 11*:85, 87. 1959. H. C. Smith.

SCIENTIFIC LIAISON SERVICE

Officer in Charge: Mr N. A. Marris

ACTIVITIES AND PROJECTS

London—The office has continued to act on a number of Commonwealth and special committees. The Senior Scientific Liaison Officer has been re-elected to the Council of the Royal Institute of Chemistry as member for overseas, he also represented New Zealand at the Commonwealth Food Working Committee meeting in London.

An increasing interest has been taken in atomic energy affairs.

Close liaison has continued with the Committee on Applied Research of the O.E.E.C. and the contacts made with leading European scientists have proved most useful. One of the large problems in the West is the matter of translation of Russian and Chinese scientific literature.

Conferences attended by the Assistant Scientific Liaison Officer included the British Association for the Advancement of Science, the British Weed Control conference, the Easter School in Agricultural Science, the European Meeting on the Use of Ionizing Radiations for Food Preservation, and a Symposium on Physics in Dairying. Reports of these conferences have been sent to the workers concerned in New Zealand. In

addition a large number of visits have been made to scientific research institutions, such as industrial research associations, branches of the U.K., D.S.I.R., and the Agricultural Research Association, and industrial research laboratories. Information on research programmes and new instruments and techniques has been forwarded to New Zealand. Exhibitions of scientific interest, such as those of the Physical Society and the Institute of Biology, have provided other occasions for obtaining information of interest and value to New Zealand scientists.

In response to specific requests from workers in various branches of the New Zealand D.S.I.R. and other Departments, copies of publications, material, and equipment, and the latest results of research have been obtained from appropriate sources. Arrangements for visits and introductions have been made for a number of visiting New Zealand scientists, and work has continued on the interviewing of applicants, and inquirers concerning scientific posts in New Zealand.

Information on New Zealand scientific activities has been given to a large number of inquirers. Copies of departmental and other publications have been distributed, and many British and European publications obtained for transmission to New Zealand.

On behalf of the New Zealand Standards Institute, meetings of the International Standards Organisation have been attended during the year.

An exhibit on New Zealand geology and the work of the New Zealand Geological Survey was arranged for the centenary reunion display of the Geologists' Association in November last.

Washington—During the year the work of this office included the procuring of Government and private reports on scientific research in several fields, including documentation and information systems, weather control, and some aspects of space research. Several New Zealand scientists were assisted in their travels. An increasing number of requests from American sources for New Zealand research papers were filled. The Liaison Secretary attended the International Conference on Scientific Information, held in Washington, in November last year, and forwarded a large number of valuable reports to New Zealand.

SOIL BUREAU

Director: Mr N. H. Taylor

PROJECTS

Soil Surveys—Raglan County (2 m./in.); Manawatu-Rangitikei sand country (40 ch./in.); Paparua County (40 ch./in.); Upper Clutha (40 ch./in.); Upper Manuherikia (40 ch./in.); Fiji (2 m./in.). Work has been concentrated on preparing reports of completed surveys for publication. The general soil survey of South Island has reached the provisional stage: maps and an extended legend are being circulated to other Departments for final correlation of land use data.

Soil Chemistry—Residual effects of phosphate topdressing on New Plymouth black loam; soil phosphorus as related to soil development; potassium supplying power of soils; potassium fixation; survey of available minerals in soils as extracted by sweet vernal – sodium, zinc, vanadium and selenium; copper survey of main New Zealand soils; and nutrient cycle in hard beech forest.

Soil Physical Chemistry—Systematic survey of inorganic soil colloids – yellow-brown sands, brown loams, and changes due to podzolisation; physico-chemical studies of soils containing amorphous minerals; aluminium in subsurface clays of ironstone and related soils; mechanism of ion adsorption; and source of natural radioactivity in soils.

Soil Physics—Survey of physical properties of main soil groups; testing of drainage promoting chemicals – gypsum; and soil temperature regimes under cultivation and pasture.

Soil Biology—Comparison of soils under forest and under pasture following forest; a survey of protozoa in New Zealand soils; effect of earthworms on soil organic matter and plant nutrients; and microbiology of Antarctic soils.

Soil Engineering—Corrosion of mild steel, concrete, and cement-asbestos in soils; effect of rate of loading on the consolidation of soils; volume changes in triaxial test specimens; consolidation and strength characteristics of Whangamarino clay; and standardisation of the liquid limit test.

Extended Projects Undertaken Jointly with other Organisations—Water and mineral balances in the Taita native catchment – hydrology and chlorine balance; cypress chlorosis at Golden Downs State forest; influence of the grazing animal on the potassium status of the soil; effect of stock treading on pasture soils; soil structure of cropped soils; soil and leaf micro-organisms in relation to animal health; *Sporidesmium bakeri* in relation to facial eczema – distribution and factors influencing growth and toxin production; and relation of dental caries to soil type – comparison of conditions at Napier and Hastings.

PUBLICATIONS

Soils and Agriculture of the Oroua Downs, Taikorea, and Glen Oroua Districts, Manawatu County. *N.Z. Soil Bureau Bull. 16*:55 pp. J. D. Cowie and B. A. J. Smith.

The Earthworm Fauna of New Zealand. *N.Z. Dept. sci. industr. Res. Bull. 130*:485 pp. K. E. Lee.

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The Influence of Media on the Counts of *Clostridium butyricum* on Soil. *Nature 181*:1142–43. D. J. Ross.

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The Approach to Research by Soil Bureau. *N.Z. Sci. Review 16*:24–26. N. H. Taylor.

Soil Science and New Zealand Prehistory. Ibid. *16*:71–79. N. H. Taylor.

Pollen Analysis and Archaeology. Ibid. *16*:27–28. W. F. Harris.

Determination of Manganese in Milk. *J. agric. Food Chem. 6*:606–608. W. B. Healy.

The Effect of Different Phosphate Fertilizers on Soil pH and the Consequent Effect of Phosphate Retention. *N.Z. J. agric. Res. 1*: 675–682. W. M. H. Saunders.

Biological Studies of Some Tussock Grassland Soils. *N.Z. J. agric. Res.*—

I—Introduction, Soils and Vegetation. *1*:913–921. R. H. Thornton.

II—Fungi. *1*:922–938. R. H. Thornton.

III—Yeasts. *1*:939–942. M. E. di Menna.

IV—Bacteria. *1*:943–957. J. D. Stout.

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VI—Nitrifying Activities. *1*:968–973. D. J. Ross.

VII—Protozoa. *1*:974–984. J. D. Stout.

VIII—Streptomycetes, *1*:985–990. T. R. Vernon.

IX—Algae: Preliminary Observations. *1*:991–997. E. A. Flint.

X—Earthworms. *1*:998–1002. K. E. Lee.

XI—The Response of a Tussock Plant, *Festuca novae-zelandiae*, to Fertilizers. *1*:1003–1005. T. M. Morrison.

The Relationship Between the Presence of Fungal Spores and a Test for Hepatotoxic Grass. *Nature 182*:1095–1096. J. C. Percival and R. H. Thornton.

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Measurement of Flow in a Small Stream. Ibid. *2*:41–45. F. W. Taylor.

A Hepatotoxin from *Sporidesmium bakeri* Capable of Producing Facial Eczema Diseases in Sheep. *Nature 183*:63. R. H. Thornton and J. C. Percival.

TOBACCO RESEARCH STATION

Director: Mr R. Thomson

PROJECTS

Seedling Bed Work

Alternatives to steam sterilisation for the control of weeds and disease; control of bed rots *(sclerotinia* and *botrytis)* by the use of fungicides; testing of various combinations of fungicides and insecticides on tobacco seedlings; and alternative materials for seedling bed covers.

The Crop in the Field

Fertilisers—Response of tobacco to minor elements, copper, manganese, zinc, molybdenum; fertiliser requirements under irrigation; varietal response to fertilisers; and demonstration plots to illustrate various deficiencies.

Cultural—Effect of spacing plants on total yield and quality of leaf, two varieties; cultivation practices in relation to yield of leaf and spread of mosaic; irrigation studies on the water requirements of the tobacco crop; and effect of chemical and hormone weedkillers on the tobacco plant.

Plant Breeding—Breeding for resistance to black root rot, mosaic, verticillium wilt and *Phytophthora* canker; and studies of inheritance.

Variety Trials—Testing of new overseas varieties and locally developed lines.

Seed Production—Testing of locally raised lines against originally imported seed; production of nucleus lines of progeny tested seed; and maintenance of a supply of seed for the industry.

Kilns and Curing—Determination of temperature and humidity limits under controlled conditions with a view to preventing mould in kilns; investigation of faults in curing; and technical advice on kiln design and management.

Diseases—Control of verticillium wilt by soil treatments; development of methods of applying fungicides on a field scale; use of fungicides to control *sclerotinia, botrytis* and *pythium* in the field; study of kiln conditions conducive to mould development; and control of root-knot nematode by soil fumigation.

PUBLICATION

The Effect of Several Fungicides on Stem Rot of Tobacco. *N.Z. J. agric. Res. 1*:866–873. A. G. McLeod and R. Thomson.

WHEAT RESEARCH INSTITUTE

Director: Mr E. W. Hullett

Services—Experimental determination of the milling and baking qualities of new wheats produced at the Crop Research Division; routine wheat and flour testing for millers, bakers, and the Wheat Committee; and technical advisory service for millers, bakers, and other flour users.

Projects—Evaluation of Hagberg test for sprout damage and Zeleny test for wheat quality, and investigation of the mechanisms of such tests; dough ripening process and causes of grey crumb colour in bread; properties of endosperm proteins in relation to dough structure and the action of maturing agents; analysis of the effects of sifting on flour colour; effects on dough of variations in tension imposed by moulders; production planning in mechanised bakeries; and use of steam in bakeries.

PUBLICATIONS

Bakers' Problems as Related to Inspectors' Work. *N.Z. Sanitarian. XIII (4)*. 1958. E. W. Hullett.

Growers Should Concern Themselves with Milling and Baking Qualities of Wheat. *N.Z. Young Farmer 11 (2)*. 1959. E. W. Hullett.

INCORPORATED RESEARCH ASSOCIATIONS

NEW ZEALAND LEATHER AND SHOE RESEARCH ASSOCIATION (INC.)

Director: Mr F. W. Woodroofe

The results of the Association's research on calfskin curing have been applied by all works handling bobby calves and the New Zealand cure is now recognised by world markets as being completely satisfactory.

Trials have been carried out on hide curing using bactericides as separate treatment and incorporating the bactericide in the salt. The salt mix proved to be the more efficient. It was found that chlorinated phenols caused colour changes in the veins giving a pronounced dark pattern over the flesh side of the hide. When boric acid and naphthalene were used in the salt, the hides opened out clean and free from red heat after 10 months in cure, and after transport to Europe and back. This work is being extended; large-scale trials have now been down for four months and some works are already using salts with these chemicals added.

Application of synthetic resins to upper leathers to improve calf and side leathers has been introduced into several tanneries and has proved of real value, giving fuller flanks and greater utilisation of the leather. It has also assisted in the production of pastel colours, the brighter base shade making the production of such colours easier.

Wax mixtures for use in impregnating sole leather to give improved waterproof properties and extended wear have been developed and trials are being conducted by the Army. The Association has modified the Army boot to meet present-day requirements; these are now under trial.

Because of restrictions on certain imports, the Association was called upon to examine and prepare suitable replacements for many imported cleaners and shoe "findings". Local rubber manufacturers have entered the market for resin rubber and microcellular soling. The Association carried out exhaustive tests and has established standards to which these materials must conform before they can be regarded as satisfactory.

The number of inquiries dealt with during the year was 570.

PROJECTS

The application of salt and bactericides to hides; the use of low alkali paints in fellmongering; the investigation of chrome zirconium tannages on calf to give a white base tannage; temperature control of tanning processes and the effect on strength of the grain; impregnation of sole leather to increase wear and waterproof properties; the use of highly polar compounds in place of the normal fatliquoring materials; the development of perspiration resistant footwear using semichrome or retan insoles and rot-proof linings and threads; the production of aniline calf and side leathers; the application of modern adhesives in footwear manufacture and production and quality control.

RESEARCH INSTITUTE OF LAUNDERERS, DRYCLEANERS AND DYERS OF N.Z. (INC.)

Director: Mr N. S. Whittall

Long-term washing experiments using various washing processes and machines have been carried out on new fabrics and on similar fabrics which have been subjected to normal household use. The trials are still continuing, but results to date show that, no matter what process or machine is used, there is a gradual loss in whiteness and strength, even in new fabrics. This serves to show that some form of bleaching is required to restore the original colour lost through the washing process.

In processes using soap and alkali it was found that, even with excessive rinsing, some alkali build-up occurred in the new fabric. This did not occur in fabrics subjected to use and wear. Fabrics treated with optical white dyestuffs showed a very rapid colour loss and a tendency to pick up metallic impurities from wash liquors, which cause a pinkish discoloration of the fabric. This discoloration appeared to be greater with processes using liquid detergents than with those using soap and alkali, and once it has occurred is difficult to remove.

Investigations have been carried out on the use of various bactericides and fungicides as part of, or in addition to, the various washing procedures. This work is particularly applicable to hospital blankets, where cross infection is a problem, and to continuous roller towels where infection and mildew staining have to be eliminated.

Plant visits have been continued and these, combined with various technical conferences and training courses, have served to keep the industry in close touch with the Institute and with new developments and techniques.

Routine inquiries into causes of damage during wear, drycleaning and laundering showed a substantial increase over the preceding year, as also did the investigations into serviceability of new fabrics.

During the year 10 technical bulletins were issued.

PROJECTS

Washing trials, using various processes and machines; the discolouring effect of metallic impurities on optical white dyestuffs; the effect of trace elements in drycleaning solvents, particularly iron, on fabrics and dyestuffs; and the use of sodium perborate bleach, which is non-degradative, as compared with the usual sodium hypochlorite bleach, which can cause serious degradation.

THE DAIRY RESEARCH INSTITUTE (N.Z.)

Director: Dr H. R. Whitehead

PROJECTS

Cheesemaking—Comparison of freeze-dried starter cultures with the same cultures preserved by other methods and with cultures transferred daily; changes in the bacterial flora of cheese during the ripening process and investigation of the effect of various bacteria on the development of flavour in cheese; the effect of modifications in cheese manufacture on the physical characteristics of the cheese and upon the

occurrence of discoloration; the effect of antioxidants on the occurrence of discoloration in cheese; investigation of the metabolism of the lactobacilli; attempts to isolate and identify the flavouring substances in cheese; properties of different wrapping materials for the packaging of rindless cheese; methods of packaging of rindless cheese; effect of storage on the oxidisability of fat in cheese; and development of a process for making cheese powders and similar products.

Buttermaking—Effect of temperature of preheating of cream on the flavour and quality of butter; nature of tainting substances in feedy cream; body of butter as affected by temperature treatment of cream; effect of conditions of manufacture on moisture distribution after reworking; causes of streaky colour in butter; wrapping materials for bulk packaging of butter; preparation of butters of particular types to suit potential buyers; preparation of butter derivatives for particular markets; and design of cream treatment plant with variable deodorising characteristics.

Casein—Estimation of lactose in lactic and rennet caseins; study of wet heat test for rennet casein; measurement of losses of casein fines and investigation of methods for recovering fines from whey and wash waters; investigations of casein washing efficiencies; and investigations of grinding and sieving efficiencies in practice.

Lactalbumin—Estimation of casein in lactalbumin slurry and in dried lactalbumin; investigation of the effect of particle size of ground lactalbumin on the colour of the product; and trials of improved methods of drying.

Dried Milk—Chemistry of changes in dried milk during storage at high atmospheric temperatures. Studies on rates of cooling of powders in various types of powder coolers; and investigation of evaporation rates and scaling factors for a triple effect evaporator.

Dairy Husbandry—Effect of different grass species in pasture for cows on properties of butterfat; and effect of stage of maturity of grasses consumed by cows on properties of butterfat.

Farm Milk Cooling—Study of rates of deterioration of farm milks when stored at various temperatures; investigation of efficiencies of cooling methods; and development of refrigeration system for farm vats.

Factory Steam Supplies—Investigation of effect of intermittent boiler firing methods on boiler efficiencies; and trials of oil-fired packaged boilers.

Advisory and Service Section—Detailed advisory work on boiler installations, air conditioning systems, and casein plants; and machinery testing for manufacturers and importers.

PUBLICATIONS

Phage-Organism Relationships among Strains of Streptococcus Cremoris: The Selection of Strains as Cheese Starters. *J. Dairy Res. 24*:381. 1957. H. R. Whitehead and Elizabeth J. Bush.

Changes in Size of Fat Globules in Cream During Vacreator Treatment. Ibid. *24*:372. 1957. R. M. Dolby.

The Influence of Carbon Dioxide on the Growth of Lactic Streptococci. Ibid. *25*:24. 1958. H. R. Whitehead, P. A. Jones, and P. S. Robertson.

Effects of Ingestion of Paraffins by Ruminants. II – Ingestion of Heavy Liquid Paraffin by Milking Cows in Relation to Yield and Composition of Milk and to Properties and Fat-Soluble Vitamins of Butterfat. *N.Z. J. sci. Tech. A38*:839. 1957. F. H. McDowall, W. A. McGillivray, and C. S. W. Reid.

Effects of Ingestion of Paraffins by Ruminants. III – Effect of Paraffin Oil on the Levels of Carotene and Vitamin A in the Blood Plasma and Milk Fat on Cows – A Further Investigation. *Ibid. A38*:878. 1957. W. A. McGillivray.

Phospholipids in New Zealand Dairy Products. I – The Estimation of the Total Phospholidips and of Lecithin, Cephalin and Sphingomyelin in Butter. *J. Dairy Res. 25*:192. 1958. A. K. R. McDowell.

Bloat in Cattle. V – Effects of Ingestion of Whale Oil on Production and Composition of Milk, on Flavour of Milk and Butter, and on properties of Butterfat. *N.Z. J. sci. Tech. A38*:1036. 1957. F. H. McDowall, M. R. Patchell, and C. S. W. Reid.

The Properties of New Zealand Butters and Butterfats, V – Milks and Butterfats from Monozygotic Twin Cows. *J. Dairy Res. 25*:159. 1958. F. H. McDowall and M. R. Patchell.

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Bloat in Cattle. VI – Effects of Ingestion of Linseed Oil, Soya-bean Oil, Mixed Beef and Mutton Tallow, and Peanut Oil on Production and Properties of Milk and Butterfat. *N.Z. J. sci. Tech. A38*:1054. 1957. F. H. McDowall, C. S. W. Reid, and M. R. Patchell.

Phospholipids in New Zealand Dairy Products II – Seasonal Variations in the Phospholipid Content of Butter and of Milk and Cream. *J. Dairy Res. 25*: 202. 1958. A. K. R. McDowell.

Progress in the Engineering of Dairy Processing. *Aust. J. Dairy Tech. 12*:150. 1957. J. K. Scott.

THE MEAT INDUSTRY RESEARCH INSTITUTE OF NEW ZEALAND (INC.)

Director: Mr N. H. Law

Considerable progress has been made in establishing the Institute in its permanent headquarters at Ruakura, Hamilton. The final plans of the new laboratories were approved by the executive in October 1958, and tenders were called and the contract let in February 1959. It is hoped the Institute will occupy its new headquarters in late 1960.

PROJECTS

Energy Control in Muscle—Work has continued on the "relaxation factor" in muscle. As a result of recent work, the factor has been rendered much more stable after extraction, and it is now realised its earlier supposed instability was largely due to the labile nature of the muscle fibres which are used in the test system, and not to the factor itself. Magnesium is essential for factor activity, while calcium must be rigorously excluded; calcium binding materials, in fact, will imitate the factor.

Proteolysis in the Aging of Muscle Tissue—The biochemical changes involved in the aging of beef have been studied, by determining the extractability of proteins in water and Weber-Edsall solution, changes in non-protein nitrogen and free amino acids, end-groups to detect proteolysis. The electro-phoretic pattern of Weber-Edsall extracts of muscles subjected to aging has been investigated and a histological study of these muscles was undertaken. As a general conclusion it does not appear so far that proteolysis is a significant factor in the tenderising of beef by storage.

State of Contraction and Tenderness in Beef—Myofibrils have been examined for changes in striation pattern on aging, but results were negative. However, a gradation of contraction patterns in the myofibrils of the *longissimum dorsi* muscle was revealed. In a study of this and other muscles by phase contrast and electron microscopy, it became clear that muscle in *rigor* offers a complete selection of myofibrils fixed at varying sarcomere lengths from 3·7 to 0·7 microns. The study was extended to include eight different muscles in *rigor* representing a complete range of tenderness.

It would appear that the degree of contraction can be a significant factor in the tenderness of good quality muscles but this effect may be masked by connective tissue in tougher muscles.

The Reamination of Inosine Nucleotides in Mammalian Skeletal Muscle—The resynthesis of adenine nucleotides from inosine nucleotides in mammalian skeletal muscles have been studied. It has been found that in muscle extracts inosine monophosphate condenses with aspartic acid to form adenylosuccinic acid. Guanosine triphosphate is required as a confactor which is bound strongly to the enzyme adenylosuccinate synthase causing the condensation. The pH optimum of the reaction is between pH 6·9 and 7·0.

The significance of such nucleotide reaminating reactions is not known. If, as has been reported, the rates of these reactions increase with increase in muscular activity, it is possible that they play an important role in muscular contraction.

Salmonella—The investigation into the origin of Salmonella infection of stock has continued, the object being to trace the source of infection and devise methods for its control. Techniques for isolating Salmonella have been studied and phage typing of the isolants have been carried out by the Central Reference Laboratory, Colindale, London. Evidence suggests so far, that the infection of stock originates on the farm with the possibility of it spreading during the transportation and holding of stock.

Freezing of Cartoned Meat—A study of the rates of freezing relatively large blocks of boneless meat was undertaken to provide basic criteria for the guidance of industry.

An experimental blast freezing tunnel was used in which meat could be frozen under controlled conditions. Both the freezing conditions and the size and shapes of the cartons were varied.

A modification of a formula developed by Plank was found to fit experimental results sufficiently closely, whereby the time required for freezing a carton of meat under conditions of plant operation could be predicted.

Automatic Weighing—The automation of weighing lamb and mutton carcases has been explored.

Weight Loss of Thin Ewes During Processing and Storage—The weight loss involved in processing and storing thin ewe carcases wrapped in stockinette and plastic wraps is being determined.

PUBLICATIONS

Some Chemical and Structural Properties of Paramyosin. *J. Biophys. and Biochem-Cytol. 3*:889. 1957. R. H. Locker and R. O. Schmitt.

Further Experiments on the Heat Coagulation of Myosin. *Biochim. Biophys. Acta. 32*:189. 1959. R. H. Locker.

Rigor Mortis and Thaw *Rigor* in Lamb. *J. Sci. Fd. Agric. 9*:417. 1958. B. B. Marsh and J. F. Thompson.

The Estimation of Inorganic Phosphate in the Presence of Adenosine Triphosphate. *Biochim. Biophys. Acta. 32*:357. 1959. B. B. Marsh.

THE NEW ZEALAND FERTILISER MANUFACTURERS' RESEARCH ASSOCIATION (INC.)

Director: Dr B. W. Doak

Superphosphate Production Studies

Basic work has continued on the project reported last year on the structure and manufacturing characteristics of Nauru and Ocean Island phosphate rocks. These data are required in order to determine conditions that will give the highest yield of superphosphate of satisfactory physical and chemical composition per ton of rock or of acid.

Overseas research work in the same field has been limited to North African and American types of phosphate rocks which differ markedly from the Pacific Island rocks in phosphate content and availability, ultimate particle size, and carbonate and silica content. Nauru and Ocean Island rocks are generally less reactive than North African rocks, on account of their larger ultimate particle size and low carbonate content. Because of their very low silica content, very little of the fluorine present escapes during the manufacturing process as compared with other phosphate rocks.

When phosphate rock is mixed with sulphuric acid to produce superphosphate fertiliser, there are a number of variables, all of which have been studied at some length. The final chemical composition of the superphosphate is basically a mixture of water-soluble mono calcium phosphate and calcium sulphate (anhydrite), together with smaller amounts of moisture, free phosphoric acid, available dicalcium phosphate, and unchanged phosphate rock. The relative proportions of these components are largely determined by the strength of sulphuric acid used and by the relative proportions of rock and acid present. Analysis at maturity of laboratory mix superphosphate indicates that increase in acid strength tends to give a product with low moisture and high total phosphate content, associated with high water solubility and low free acid. An increase in the proportion of sulphuric acid used leads to high water solubility, but this is counterbalanced to some extent by low total

phosphate, high moisture and high free acid content. Optimum physical condition and chemical composition of the superphosphate occurs over a relatively narrow range of acid strengths and acid-rock ratios.

The mechanism and rate of the chemical reaction has been followed by analysis of the various components at a number of points between mixing and maturity. Initially, a relatively fast reaction occurs between rock and acid to produce phosphoric acid and calcium sulphate, until no more free sulphuric acid is present. The subsequent slow reaction is between phosphoric acid and unchanged rock to form mono calcium phosphate. Eventually a state of equilibrium is reached at maturity. The factors which increase the speed of initial reaction and consequently decrease the time taken to attain equilibrium have been found to be: (1) increased fineness of grinding of phosphate rock; (2) decrease in proportion of sulphuric acid present ("under-acidulation"); (3) decrease in acid strength; and (4) increase in initial acid temperature (within normal limits). The majority of the work was duplicated with both Nauru and Ocean Island rocks and no significant difference was detected between them, both being of similar grade and chemical composition.

On the whole, the behaviour of these phosphate rocks parallels that of the North African rocks in superphosphate manufacture as far as overseas data are available for comparison purposes. The chief differences are those to be expected from the higher grade and low reactivity of the local rocks. Further work on this project is proceeding.

PROJECTS

Acidulation of rock phosphates – laboratory and work studies; incorporation of DDT into superphosphate – problems of works mixing; cattle-tick control by superphosphate containing DDT or dieldrin; effect on soil of long-term usage of various phosphate fertilisers; and sulphur in rain and leaching of sulphur from soils.

THE NEW ZEALAND POTTERY AND CERAMICS RESEARCH ASSOCIATION (INC.)

Director: Mr I. C. McDowall

Unsatisfactory performance of unreinforced brick buildings when subjected to earthquake loads has, in recent years, restricted the use of this building material to non-load-bearing work and infilling panels. Confidence in the qualities of bricks for use as a load-bearing material led to an investigation by the Research Association of the system of reinforced brick construction that was developed in the United States of America and which has found favour in California. This system has now been introduced to the New Zealand building industry, and in the past year considerable progress has been made with its application. A series of bulletins have been issued to the building trades and professions and interest in the possibilities of the system has quickened with the completion of a block of two shops and a flat at Lower Hutt. Several other commercial buildings have been erected in the Auckland area and it has been established that reinforced brickwork is fully competitive with other forms of construction for this class of work.

PROJECTS

Plastic and drying properties of clay bodies; test methods for determining the dry strength of clays; fired properties of field tile and pipe clays; automatic stokers for intermittent kilns; and bond of brick-mortar units.

PUBLICATION

The Properties of Reinforced Brickwork. *Building Progress 23 (8)*: 25–30. V. A. Youl.

THE NEW ZEALAND WOOL INDUSTRIES RESEARCH INSTITUTE (INC.)

Director: Dr L. F. Story

Thyroxine and Iodine Trials—The third annual implantation of a group of Romney ewes at Invermay with 90 mg of *l*-thyroxine, in March 1958, again resulted in a small, non-significant, increase in wool production. Full mouth Romney ewes have been given iodine in three forms – thyroxine, Neo-Hydriol and potassium iodide. Neo-Hydriol and potassium iodide decreased the thyroid cell heights and increased the iodine contents, whereas the thyroxine implantation slightly reduced the thyroid cell heights but did not affect the iodine content. All three treatments resulted in a reduction in weight of the thyroid glands, but had no appreciable affect on fleece weight. Thyroxine implantations may stimulate wool growth because of a borderline iodine deficiency. A large increase in heart rate for a considerable period following thyroxine implantation in November did not result in any increase in wool growth. Neo-Hydriol (iodinated poppy seed oil) injections provide supplementary iodine for a considerable period.

Staple Strengths—There is a marked deterioration in staple strength during the selling season. A high correlation was found between subjective hand estimates of staple strength and machine measurements. Practical woolmen would not distinguish between the degrees of strength of the stronger staples, and work is planned on the significance of staple strength in processing.

Work is continuing on the basis of staple strength measurements and also on the strength of fibre bundles from combed tops.

Wool Drying—The Dominion Laboratory has collaborated in measurements on rate of drying and in designing a test-dryer for measuring the moisture content of wool rapidly and directly.

Effluent Disposal—Some preliminary work has been done on this subject which is becoming a problem for the industry, particularly in regard to disposal of woolscouring liquors.

Stained Blankets—A case involving streaks and dingy colour in a considerable quantity of blanket material in the course of production was investigated. The cause was ascertained and a simple cure was found. This resulted in the whole of the material being finished as first-class goods with little increase in cost, while steps have been taken to prevent a reoccurrence of the trouble.

Waterproofing—New and effective methods have recently been developed but the effectiveness is liable to be lost in dry cleaning through masking by the detergents now commonly used. Tests have shown that some cleaning processes are harmless to the proof, while others mask the proof completely and moreover may prevent reproofing by another method.

PROJECTS

Effluent disposal; strength of wool in relation to growth and manufacturing; fibre breakage in processing; wool drying and measurement of moisture content; effect of oil in woollen processing; comparison of detergents and builders in scouring; and levelness of tops and yarns.

PUBLICATIONS

Hormone Implants in Wool Production. *N.Z. J. Agric. 97*:377–380. D. A. Ross.

The Effect of Thyroxine on the Romney Two-Tooth. *Proc. N.Z. Soc. Animal Prod. 18*:141–152. D. A. Ross.

A New Deal for Wool. *Wool 3(1)*:49–51. L. F. Story.

GRANT-AIDED RESEARCH IN OTHER INSTITUTIONS

On p. 8 are shown the annual grants made by the Department to assist research in other institutions.

CANTERBURY AGRICULTURAL COLLEGE

Director and Principal: Dr M. M. Burns

PROJECTS

Agricultural Economics—Income and resource productivity in New Zealand farming 1922–56.

Agricultural Engineering—Reactions of mounted ploughs upon tractor-guiding instrument; and hay curing.

Agricultural Microbiology—Microbiology of wool; rhizobium inoculation of legumes; soil microbiology; and disease survey and plant pathology.

Agricultural Zoology—Bird ecology; thrips infestation of cocksfoot seed crops; and pollination of red clover.

Animal Husbandry—Border Leicester-Romney trial (grades); Border Leicester-Romney (studs); thyroxine implantation; use of lucerne for flushing ewes; ram fertility study; stud records; and intake studies.

Field Husbandry—Lucerne pasture mixtures – Ashley Dene; improvement of M. glutinosa; and lucerne problems.

Horticulture—Studies in glasshouse environmental control, with particular reference to temperature, light, ventilation, and humidity; and miscellaneous tomato trials.

Soil Science—The nitrogen cycle in grassland soils – studies in soil organic matter; the nutrition of legumes; and lime studies.

Veterinary Science—White muscle disease trials; ill-thrift trials includin the use of Selenium, other micronutrient trials; and "Frantin" trial.

Wool—Studies in fleece rot; studies on wool break; application of compressometer technique for measurement of density and fineness of crossbred wools; documentation of wool production within a self-maintaining Corriedale flock; prediction of adult fleece from lamb coat; and application of progeny test and half-classing methods in Merino ram selection.

PUBLICATIONS

The Effect of Thyroxine on Wool Growth and Lamb Production. *N.Z. J. agric. Res. 1*:365–381. 1958. I. E. Coop and V. R. Clark.

Results from Mist Propagation Systems with Comments on their Management. *J. roy. N.Z. Inst. of Hort. III (1)*. Dec. 1958. S. Challenger.

Competition for Sulphur in a Grass-Clover Association. *Plant & Soil 9*: 353–66. 1958. T. W. Walker and A. F. R. Adams.

Studies on Soil Organic Matter I – The Influence of the P Content of Parent Materials on the Accumulation of Carbon, Nitrogen, Sulphur and Organic Phosphorus in Grassland Soils. *Soil Science 85*:307–18. 1958. T. W. Walker and A. F. R. Adams.

Studies on Soil Organic Matter II – The Influence of Climate on the Accumulation of Carbon, Nitrogen, Sulphur, and Organic Phosphorus. *Soil Science 87*:1–10. 1959. T. W. Walker and A. F. R. Adams.

Studies on Soil Organic Matter III – The Accumulation of Carbon, Nitrogen, Sulphur, Organic and Total Phosphorus in Improved Grassland Soils. *Soil Science 87*:135–140. 1959. T. W. Walker, B. K. Thapa, and A. F. R. Adams.

The Significance of Phosphorus as a Factor in the Accumulation of Organic Matter in Soils. *N.Z. Soil News. No. 5*. 1958. A. F. R. Adams.

Total Counts of Micro-organisms in the Fleece of Two Corriedale Fleece Types. *Aust. J. agric. Res. 9*:704–707. A. P. Mulcock and I. E. B. Fraser.

CAWTHRON INSTITUTE

Director: Dr D. Miller

The grant-in-aid from the Department of Scientific and Industrial Research has been devoted to researches on plant nutrition concerned with hops, tobacco, soils, fruits, and tomatoes. Collaboration with the Hop and Tobacco Research Stations at Riwaka has been maintained.

PROJECTS

Hop Research—An important service to the hop industry has been the establishment at the Marsden Farm of a hop nursery for the propagation of certified hop sets of disease-resistant strains bred at the Hop Research Station.

The researches on the influence of minor elements, sources of nitrogen, the composition of fertilisers on yield, changes in the chemical composition of cones and roots, resin contents of cones in different varieties, and the nutrition of root-rot in relation to organic and inorganic fertilisers are being continued. The testing of varieties for virus infection inaugurated last year, together with fungal researches, will be transferred to the care of the Department of Scientific and Industrial Research.

Tobacco Research—Researches on the mineral, nitrogen, sugars, and minor elements in the plants grown in field trials; study of the chemical changes in plants during the growing season and in the leaves from harvesting to maturation; and analytical investigation into the possible chemical structure of varieties in relation to disease.

Fruit Research—Development of the project on the chemistry of apples in relation to bitter-pit, the studies following the chemical changes in the leaves and fruit in relation to the incidence of the ailment; work on minor elements in relation to small fruits; and the influence of nutrition on the growth of raspberry canes.

Tomato Research—The influence of minor elements on the incidence of a chlorotic foliage condition in order to ascertain the cause of the condition; the influence of temperature, time of sowing and rapidity of seedling growth on the development of lower trusses of fruit; and the elaboration of a technique for controlling yield and quality by means of trickle irrigation.

In the water-culture experiments concerning "cloud", and following up last year's researches, a study will be made of the effect of osmotic pressure and related factors on "cloud", as well as on the distribution and action of polyphenol oxidase, together with an identification of abnormalities in susceptible cells.

Pasture Research—The work on the experiments with major and minor elements in relation to pasture components on pakihi-soil at Onekaka offers to give important results and will be continued as well as the work with lime, molybdenum, and cal-mag at 88-Valley.

Soil Research—The survey, with special reference to the alluvial soils of the Waimea County, is virtually completed.

The studies on the effects of reclamation of Moutere Hills upon the nutrient status of the soils are continuing, information being secured from areas under pasture for many years and from experimental plots.

PUBLICATIONS

Raspberries at the Marsden Research Farm. *Cawthron Institute Annual Report, 1957–58*:38. H. O. Askew.

The Effect of Magnesium Topdressings on the Growth of Young Apple Trees. *N.Z. J. agric. Res. 1*:796–799. H. O. Askew and E. T. Chittenden.

Physical and Chemical Changes in Hop Cones During Drying. *N.Z. J. Sci. Tech. 38B*:943. H. O. Askew and R. J. Monk.

Molybdenum Deficiency of the Hop. *N.Z. J. agric. Res. 1*:553–568. H. O. Askew, R. J. Monk, and Joyce Watson.

Physical and Chemical Changes in the Developing Hop Cone. *N.Z. J. agric. Res. 1*:757–777. H. O. Askew, R. J. Monk, and Joyce Watson.

Mineral and Nitrogen Content of Cox's Orange Apples in Relation to Incidence of Bitter Pit. *Cawthron Institute Annual Report, 1957–58*: 35. H. O. Askew, Joyce Watson, and E. T. Chittenden.

Nutritional Studies of *Phytophthora cactorum* (L. & C.) Schroet. I – Utilisation of Nitrogen and Carbon Compounds. *N.Z. J. Sci. 1*:83. (1958). T. B. C. Christie.

Further Nutritional Studies on *Phytophthora cactorum* (L. & C.) Schroet. *Cawthron Institute Annual Report, 1957–58*:33. T. B. C. Christie.

Water-culture Experiments on Nutritional Problems of the Tomato. *Cawthron Institute Annual Report, 1957–58*:45. E. B. Kidson.

Seasonal Changes in the Carbohydrates of Hop Plants. Ibid.:31. R. J. Monk.

Some Factors Regulating Yield, Quality, and Physiological Disorders of Tomatoes. Ibid.:47. D. J. Stanton.

Liquid Feeding of Tomatoes by Trickle Irrigation. Ibid.:50 D. J. Stanton.

MASSEY AGRICULTURAL COLLEGE

Principal: Dr A. Stewart

PROJECTS

Agricultural Biochemistry—Wear in sheep's teeth; utilisation of carotene by animals; evolution of improvements in milk analysis; and determination of minimum frequency of sampling for obtaining significant data.

Agricultural Zoology—Investigations on possible inhibition of stomach worm (Haemonchus) parasitism in sheep grazing certain grasses and clovers in pure stand; the process of development of resistance to parasitism; the epidemiology of round worm parasitism in sheep; and distribution of bumble bee species in the South Island.

Dairy Husbandry—Study of endocrine factors in relation to mammary gland growth; further investigations of the Hooker Forbes method of estimating small quantities of progesterone and its use for this purpose on the blood of ruminants; in cooperation with the Plant Chemistry Division and others, investigation of the effects of active material which might occur in pasture species, on the animals consuming pasture; and the nutritive value of whey for fattening pigs.

Sheep Husbandry—Sheep-breeding experiment; genetics of *N*-type and horns; and carcass quality and meat investigation.

Sheep Farm—Pasture manuring under rotational grazing.

Soils and Field Husbandry—Pampas research.

Veterinary—Leptospira pomona vaccination in calves.

PUBLICATIONS

Wear in Sheep's Teeth. *Proc. Ruakura Farmers' Conference Week, 1958*: 39–53. C. R. Barnicoat.

Histochemistry – a Review. *J. N.Z. Inst. Chem. 23*:3–10. 1959. C. R. Barnicoat.

Seasonal Changes in Composition of Ewe Milk Fat. *Biochem. J. 68*:644. 1958. C. R. Barnicoat with T. Gerson and F. B. Shorland.

Carcass Weight as an Index of Carcass Components with Particular Reference to Fat. *J. agric. Sci. 50*:331. 1958. R. A. Barton and A. H. Kirton.

Assessment of Fat in Mutton and Lamb. *Proc. N.Z. Soc. Anim. Prod. 18*:112. 1958. R. A. Barton and A. H. Kirton.

Quality Beef Production. pp. 108, by R. A. Barton. Published by Massey Agricultural College.

The Leg and Loin as Indices of the Composition of New Zealand Lamb and Mutton Carcasses. *N.Z. J. agric. Res. 1*:783. 1958. R. A. Barton and A. H. Kirton.

Comparative Survey of Romneys at Feilding and Gore Ram Fairs 1958. *N.Z. Studmasters' Annual Review, 1958*. R. A. Barton.

Reproductive Disturbances of Romney Ewe Lambs Grazed on Red Clover (*Trifolium pratense*) Pastures. *Nature 182*:1175. 1958. T. S. Ch'ang.

Further Breeding Experiments with New Zealand Romney *N*-type Sheep to 1956. *Aust. J. agric. Res. 9*:348–362. 1958. F. W. Dry.

The Use of Condensed Whey as a Food for Fattening Pigs. *N.Z. J. agric. Res. 1*:531–539. 1958. A. C. Dunkin.

Mammary Gland Growth in Male Mice of the CHI Strain after Hypophysectomy and Castration. *J. Endocr. 17*:300–306. 1958. D. S. Flux.

Specific Gravity as an Index of the Fat Content of Mutton Carcasses and Various Joints. *N.Z. J. agric. Res. 1*:633. 1958. A. H. Kirton and R. A. Barton.

Liveweight Loss and its Components in Romney Ewes Subjected to *l*-Thyroxine Therapy and a Low Plane of Nutrition—

I—Effects on Liveweight, Carcass Weight and Carcass Composition. *J. agric. Sci. 51*:265–281. 1958. A. H. Kirton and R. A. Barton.

II—Effects on Some Non-carcass Components of Liveweight. Ibid. *51*:282–288. 1958. A. H. Kirton and R. A. Barton.

Effects of Ingestion of Paraffin by Ruminants. VI – The Ingestion of Heavy Liquid Paraffin by Cows near Parturition in Relation to Milk Yield and Composition and to Fat Soluble Vitamin Content of the Butterfat During the Early Stages of Lactation. *N.Z. J. agric. Res. 2*: 35. 1959. W. A. McGillivray, F. H. McDowall, and C. S. W. Reid.

Vitamin A – an Assessment of Present Knowledge. *J. N.Z. Inst. Chem. 22*:159. W. A. McGillivray.

The Nutritive Value of Milk and Milk Products. *J. Dairy Res. 25*:344. W. A. McGillivray.

Factors Influencing the Vitamin Content of Milk. VIII – The Influence of Various Factors on the Utilization of Carotene. *J. Dairy Res. 25*: 439. 1958. W. A. McGillivray, S. Y. Thompson, and N. A. Worker.

Bloat in Cattle. XII – The Effect of Orally Administered Penicillin on Body-weight of Lactating Cows, on Milk Production, and on Production and Composition of Fat. *N.Z. J. agric. Res. 2*:62. 1959. A. T. Johns, F. H. McDowall, and W. A. McGillivray.

Thyroid Follicular Cell Height; a Note on the Absence of a Significant Effect of *l*-Thyroxine in Romney Ewes. *N.Z. J. agric. Res. 1*:83–85. 1958. R. E. Munford and A. H. Kirton.

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Methods of Selection for Lamb Production. *Sheepfarming Annual 1958*: 231–238. A. L. Rae.

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Wool Follicle Development in the New Zealand Romney and *N*-type Sheep. II – Follicle Population Density During Foetal Development. *Aust. J. agric. Res. 9*:138–160. 1958. S. K. Stephenson.

The Sheep Ked, *Melophagus ovinus*—

I – Dissemination Potential. *Parasitology 48*:353. 1958. J. H. Tetley.

II – Keds Acquired by a Lamb from its Mother. Ibid. *48*:364. 1958. J. H. Tetley.

A Nomograph for Calculating S.N.F. Content of Milk from Density Hydrometer Readings and Fat Percentage. *Dairy Ind. 22*:1030, 1031. 1957. G. M. Wallace.

Susceptibility of the Hedgehog (*Erinaceus europaeus* L.) to Infection with *Leptospira pomona*. *Nature 180*:1372. 1957. W. M. Webster.

UNIVERSITY OF AUCKLAND

SEAGROVE RADIO RESEARCH STATION

Research Fellow in Charge: Dr H. A. Whale

Work has continued on long-distance radio transmissions. Very large changes in the direction of signals from nearly antipodal stations (e.g., U.K.) have been shown to be associated with the changes in the position and shape of the auroral regions. This has lead to a direction-finding method of investigating the auroral regions.

To provide information on the causes of the vertical spreading of incoming waves, an instrument has been designed to record simultaneously rapid fluctuations in bearing, elevation angle, and amplitude of fading signals.

Some of the results and conclusions obtained so far have been published, or submitted for publication, in overseas journals.

Much equipment and accommodation at Seagrove is now requiring extensive maintenance and renovation. This problem, and that of encouraging staff to work at Seagrove, which is remote from Auckland, has raised the question of an alternative site, or of the provision of suitable housing in a more centrally situated locality, e.g., in Papakura or Ardmore, and transport to Seagrove.

UNIVERSITY OF CANTERBURY

INDUSTRIAL DEVELOPMENT DEPARTMENT

Director: Mr T. R. Pollard

There has been a further increase in the financial recovery, which, this year, was £21,000 as compared with £19,000 last year. The total expenditure was £29,400 as compared with £27,000 last year. Industrial recovery was £10,300 as compared with £9,300 last year.

A major project during 1958 was the construction for the Physics Department, University of Canterbury, of a fixed frequency ionosphere recording mechanism to enable research in the Antarctic, on the D-layer, to be carried out. The apparatus was completed in December and dispatched in the U.S.N.S. *Wyandot* and, upon arrival in the Antarctic, was immediately put into commission and good echoes were received as soon as it was connected to the aerial. This says a great deal for the design, manufacture, and packing. During construction of the apparatus, technicians from the Physics Department were seconded to I.D.D. and helped with the construction.

After six months' research into electrically heated blanket fires an interim report has been circulated to various manufacturers, importers, and Government Departments. It is expected that the findings of this work will be issued in June or July and will have considerable influence on the preparation of a New Zealand Standard.

As the result of import control a number of New Zealand firms are commencing manufacture of electrically heated blankets. For this reason I.D.D. has been engaged on various material tests to determine their suitability for blanket manufacture. It is expected there will be a further series of tests to the New Zealand Standard of those blankets being manufactured here.

Apparatus dispatched to the College of Medicine at Baghdad has arrived in excellent order. Their Physics Department have advised that they are very pleased with this apparatus.

A survey of the vibrations emanating from the synchronous condensers in the Islington substation and their effects in nearby houses was carried out for the New Zealand Electricity Department. The work has been completed and reports issued to that Department.

A considerable amount of routine testing has been carried out on electrical apparatus. Manufacturing firms are making use of the testing facilities at I.D.D. for material control during manufacture, and are also making increased use of I.D.D. for advice on control apparatus.

As the result of considerable research and development an effective, reasonably priced, remote reading rain gauge has been made and subjected to about 12 months' trial. The trial has been most satisfactory. The Meteorological Service has shown interest in this rain gauge and has placed an order for 20 units which will be operated and tested throughout New Zealand, particularly in back country farm work.

ROLLESTON RADIO FIELD STATION

Officer in Charge: Dr C. D. Ellyett

The year 1958 was largely one of transition from an ad hoc group using temporary equipment to an organised research team undertaking longer projects using equipment built to engineering standards. This has been brought about largely by finance from American contracts. Research work using specially developed radar equipment has been mainly in three directions – meteor research, D-region research, and noise research.

Meteor Research—The incidence of meteor showers has been analysed and a high rate of activity recurring annually in the Southern Hemisphere in each December has been confirmed. Special equipment has been built to study the daily all-sky meteor rates throughout the year.

D-region Research—Observations on the lower ionosphere have led to new knowledge on reflections in the 50 to 85 km region. With the assistance of a Ross Dependency Research Committee grant a complete D-recorder and aerial array was built by the Industrial Development Department of the University of Canterbury and has been installed at Scott Base.

Noise Research—During auroral studies in 1957 results led to the belief that radio noise arose in the auroral regions. To investigate this a start has been made on the construction of a Riometer (relative ionospheric opacity meter) to measure ionospheric absorption by variation of received galactic noise, and hence give the true background noise.

PUBLICATIONS

Reference List of Meteor Articles with Particular Emphasis on Radio Meteors, *U.S., N.B.S. Report 5551, 1958.* C. D. Ellyett.

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Mesopause Region of the Ionosphere. *Nature 181*:753. 1958. J. B. Gregory.

COMMONWEALTH AGRICULTURAL BUREAUX

This Department, on behalf of New Zealand, is associated with the work of the Commonwealth Agricultural Bureaux (C.A.B.).

The organisation is one of the earliest established and one of the most successful on a Commonwealth-wide basis in the field of science. Commonwealth Governments contribute financially to the support of this organisation and the world-wide sale of its publications augments its funds.

The C.A.B. consists of ten bureaux, three institutes, and a headquarters, all but one of which are located in the United Kingdom. The C.A.B. prepare and publish abstracts of, and monographs based on, the world's scientific literature in the fields of agriculture, animal research, and forestry. This and the other services of the C.A.B. enable research and extension workers to keep up to date with the rapid developments in these and related subjects. The work is expanding owing to the increasing output of scientific literature and the diversity of languages in which it is published.

A review conference, held every five years, is attended by the administrative heads of agricultural research throughout the Commonwealth and provides a special opportunity for a critical examination and review of the general policy, activities, organisation, and financing of the C.A.B. In the interval between these conferences the administration of the C.A.B. is vested in the executive council (in London), which consists of representatives from the contributing countries. New Zealand is represented on the council by our Senior Scientific Liaison Officer in London.

The next review conference will be held in London in September 1960.

APPENDIX

FIRST ANNUAL REPORT OF THE ROSS DEPENDENCY RESEARCH COMMITTEE

The Hon. P. N. Holloway, Minister in Charge of the Department of Scientific and Industrial Research.

I have the honour to submit herewith the first annual report of the Ross Dependency Research Committee for the year ended 31 March 1959.

As this is the committee's first report, it is desirable to traverse briefly the steps leading to its formation, and to outline its functions.

It became increasingly clear, as the International Geophysical Year progressed that the large build-up of scientific research and exploration in Antarctica would continue after the conclusion of IGY on 31 December 1958. Evidence of the continuing collaboration between Antarctic scientists was seen early in 1958, in the formation of the Special Committee for Antarctic Research by the International Council of Scientific Unions. Several Governments announced about this time their intentions of continuing Antarctic bases after the IGY, whilst the New Zealand Government, in February 1958, made known its intention to maintain Scott Base and Hallett Station (jointly with U.S.A.) after the IGY. The Ross Dependency Research Committee was appointed in March 1958 to advise the Minister in Charge of Scientific and Industrial Research on the organisation and administration of New Zealand's activities in the Ross Dependency. The committee is charged with coordinating and supervising these activities, with particular reference to the scientific and technical programme. It is required to coordinate New Zealand activity with that of other countries operating in Antarctica, particularly in the Ross Dependency. The coordination of the publication and dissemination of the results of scientific work is also a function of the committee.

The present composition of the committee is:

Dr R. G. Simmers (Chairman), Assistant Director, N.Z. Meteorological Service, Air Department.
Dr E. I. Robertson (Vice Chairman), Director, Geophysics Division, Department of Scientific and Industrial Research.
Dr R. A. Falla, Director, Dominion Museum.
Dr C. D. Ellyett, Senior Lecturer, Physics Department, University of Canterbury (Representing the University of N.Z.).
Mr R. G. Dick, Surveyor-General, Department of Lands and Survey.
Lt. Cmdr. J. C. K. Harley, R.N.Z.N. (Representing Chiefs of Staff Committee).
Mr R. E. B. Peren, Department of External Affairs.
Mr W. H. Ward, Director, Dominion Physical Laboratory, D.S.I.R.
Mr R. W. Willett, Director, N.Z. Geological Survey, D.S.I.R.
Dr C. A. Fleming, N.Z. Geological Survey, D.S.I.R. (Representing the Royal Society of New Zealand).

Mr J. W. Brodie, Director, N.Z. Oceanographic Institute, D.S.I.R.

Dr T. Hatherton, Principal Scientific Officer, Geophysics Division, D.S.I.R.

Mr J. Holmes Miller, Antarctic Executive Officer, Antartic Division, D.S.I.R. (independent member).

Mr G. W. Markham (Secretary), Superintendent, Antarctic Division, D.S.I.R.

The Administrator of the Ross Dependency, Captain H. Ruegg, Nautical Adviser to Marine Department, attends meetings of the committee when he so desires.

The first meeting was held on 16 April 1958, and the committee has met on eight occasions in all. Various ad hoc subcommittees have dealt with different problems, whilst an executive subcommittee of six, handles urgent business between meetings.

THE ANTARCTIC RESEARCH EXPEDITIONS, 1958–59

The committee's primary task was to plan, coordinate, and supervise a scientific programme for the 1958–59 summer season and for Scott Base and Hallett Station for 1959 following the conclusion of the International Geophysical Year on 31 December 1958. Despite a late start for planning Antarctic activities, the committee is pleased to report that the planned programme, with one exception, has been successfully implemented. The exception was the Geological and Survey Expedition which did not reach its objective on the Victoria Land coast because extremely adverse weather and ice conditions made landings from United States icebreakers impossible. An alternative programme devised at short notice was put into effect with considerable success.

The gratifying achievements of the year's activities are primarily due to the enthusiasm and ability with which Antarctic staff have carried out their difficult assignments. These efforts would have been fruitless but for the munificent and wholehearted support given by the United States Naval Support Force, commanded by Rear Admiral George Dufek, and the willing support by the Royal New Zealand Navy, in particular, the ships' companies of H.M.N.Z.S. *Endeavour* and H.M.N.Z.S. *Kaniere*.

Scott Base

The relief and resupply of Scott Base was completed rapidly and without mishap early in January. The scientific programme undertaken during IGY has been modified to reduce the intensity of observations and to concentrate more on specific research problems. The strategic position of the base on a north-south line of mainly New Zealand stations running from the South Pole, Scott Base, Hallett Station, Campbell Island, Invercargill, northward through New Zealand, coupled with the excellent equipment at the Base, enables work to be done which is of considerable significance to global scientific problems. This particularly applies in the fields of upper atmosphere physics and seismology. Specifically, the programme covers the fields of ionospheric sounding, geomagnetism, aurora, seismology, meteorology, sea level recording, and glaciology. During the summer season, biological

surveys at various points on Ross Island and in McMurdo Sound were conducted from Scott Base. Gravity measurements were undertaken at points near Scott Base and on the western side of McMurdo Sound. The 1959 party of 10 has been augmented by three American guest scientists.

Hallett Station

Throughout the IGY, Hallett Station has been operated as a joint United States/New Zealand station. The United States established and maintain the station, provide the support staff and all scientific equipment. The scientific staff comprises four scientific officers. One of these is a United States meteorologist who is assisted by three U.S. Navy aerographers. The other three are New Zealand scientists who conduct the scientific programme in aurora, geomagnetism, ionosphere, and seismology. During 1958–59 summer season, one of the New Zealand scientists, who is a biologist, carried out surveys of bird life at the Hallett penguin rookery. The relief and resupply of the station was completed by an American icebreaker early in January 1959.

NEW ZEALAND GEOLOGICAL AND SURVEY EXPEDITION, 1958–59

The original plan of the expedition, which left New Zealand at the end of November 1958, envisaged landings at Wood Bay and Terra Nova Bay whence, with the aid of United States helicopter support, a number of the glacial valleys flowing into those areas would be explored, geologically and topographically. Unfortunately, ice conditions prevented the fulfilment of this plan. The expedition spent the summer in and around McMurdo Sound, carrying out detailed geological work and establishing a number of important survey stations which will serve as a network to tie in the United States trimetrigon air photographs of that area.

Geological and topographic work, including fixes of major stations, was carried out on Coulman Island, White Island, Black Island, and Beaufort Island. Other areas visited were the Wright Dry Valley, Taylor Dry Valley, Cape Chocolate, Solitary Rocks (where the type Beacon Sandstone was examined), Kukri Hills, Granite Harbour, Cape Roberts, and Cape Bird. In addition, detailed work was carried out at Cape Crozier and Minna Bluff.

A party of the expedition climbed Mount Erebus and was able to examine the crater and, in some detail, ash shower sections that surround the crater. This is an important contribution to Antarctic volcanology. In addition, Mount Terror, no longer active, was climbed and, in the course of fixing survey points, Mount Discovery was climbed for the first time; survey stations were established on both.

Although the primary objective was not achieved, the alternative plan put into operation at short notice, will undoubtedly result in a number of papers on detailed geology and a big advance in detailed knowledge of the main geological formations. McMurdo Sound is an excellent area for such detailed work and what has been carried out will form an important corner-stone in the edifice of Ross Dependency geology. The completion of the survey network referred to will enable a detailed map to be constructed from air photographs.

VICTORIA UNIVERSITY OF WELLINGTON ANTARCTIC EXPEDITION, 1958–59

The Geology Department, Victoria University, was authorised to send a four-man expedition from the university to undertake scientific investigations in the area surrounding the Wright Dry-Valley, South Victoria Land.

The expedition left New Zealand by United States air transport on 15 November 1958 and was transported by United States helicopter from McMurdo air facility to the area of operations. After being in the field seven weeks, the expedition was evacuated to Scott Base on 30 January 1959 and arrived in New Zealand on H.M.N.Z.S. *Endeavour* on 16 February 1959.

The expedition was self-supporting, being financed by the Council of the Victoria University of Wellington and the Grants Committee of the University of New Zealand. Assistance in equipment and food was given by the Department of Scientific and Industrial Research and New Zealand firms.

This small expedition successfully completed 1,000 square miles of geological reconnaissance survey and topographical mapping of this unique valley system. It is ice free, has freshwater lakes, and has a relatively warm climate, many degrees higher than the surrounding regions. In addition to gathering climatological data and many biological specimens of bird and animal life, the expedition made gravity observations from the coast to 50 miles inland, i.e., to within four miles of the polar plateau.

BIOLOGICAL SURVEYS

In the McMurdo Sound area biological reconnaissances were made at Black Island, Taylor Dry Valley, Cape Crozier, Cape Bird, Cape Royds, Beaufort Island, and Tent Island. All the penguin colonies on Ross and Beaufort Islands were visited and inspected. The seals of the region were studied, especially in respect to pupping, movement numbers, and population structure. Subfossil seals in the Taylor Valley and at Black Island were investigated. Observations were made on skuas as a contribution to the international study that is being made of this bird.

Whilst H.M.N.Z.S. *Endeavour* was at the ice edge in McMurdo Sound, routine collections were made of marine animals, using fish traps and long lines in depths from 35 to 240 fathoms.

From H.M.N.Z.S. *Endeavour* en route to McMurdo Sound, and on the return trip, detailed bird logs were kept, providing data for the analysis of sea bird distribution between New Zealand and the Ross Sea. Routine observations were also made on whale and seal distribution, especially in the pack ice.

During the course of the oceanographic cruise in the Ross Sea, routine observations on the distribution of birds, whales, and seals were continued.

Visits to Beaufort Island and points round Ross Island, which are reported on above, were made from H.M.N.Z.S. *Endeavour*.

OCEANOGRAPHIC SURVEYS

Oceanographic surveys between New Zealand and the Antarctic were continued and the first systematic survey of the Ross Sea was undertaken during the summer season.

Despite the work of previous expeditions, the state of knowledge of the Southern Ocean and the Ross Sea is such that a great deal of definitive work has yet to be done. The distribution of marine animals, of phytoplankton, and of sediments, the variations of temperature, salinity and circulation features, and the bottom topography require to be defined.

In the current season's work, of particular significance were the studies of the Antarctic Convergence and the survey of the Ross Sea. The Antarctic Convergence, i.e., where the cold Antarctic waters converge on the warmer northern waters of different origin, was traversed eastwards from near Macquarie Island to the pack ice north of the Ross Sea. A large latitudinal spread was observed trending from Macquarie Island in a south-easterly direction. An extensive ^{14}C sampling programme was carried out so that now a complete ^{14}C dating profile from surface to bottom across the convergence can be constructed. In the Ross Sea survey 20 oceanographic stations were occupied along five lines. Each station comprised complete hydrology, bottom dredging, plankton trawls, and bottom sediment cores. In addition, four bottom dredge stations were occupied round Ross Island and one ^{14}C sampling station was occupied in the McMurdo Sound.

A proton magnetometer, constructed by the New Zealand Naval Research Laboratory, was installed on H.M.N.Z.S. *Endeavour* to allow a continuous total force magnetic survey to be carried out during *Endeavour's* Antarctic cruise this season.

ADMINISTRATION OF ANTRACTIC ACTIVITIES

The Department of Scientific and Industrial Research is charged with the executive responsibility of implementing Antarctic activities. During 1957 and 1958 the execution and operation of the scientific programme has been an added responsibility of the Geophysics Division. To enable this Division to concentrate on its established functions and to achieve more unified control of Antarctic operation, a small Antarctic Division is being formed. The staff will mainly consist of existing D.S.I.R. officers.

INTERNATIONAL RELATIONS

The close cooperative spirit developed during the IGY between scientists throughout the world is being fully maintained. The IGY was planned and operated by scientists under the auspices of the International Council of Scientific Union (ICSU). This body, acting on recommendations from IGY committees, realised early in 1958 that Antarctic research would continue and set up the Special Committee on Antarctic Research (SCAR) to promote and coordinate international scientific collaboration in Antarctica. The membership of SCAR comprises the 11 countries, including New Zealand, who are working in Antarctica, plus appropriate scientific unions. The membership is through the national adhering body to ICSU which, in New Zealand, is the Royal Society of New Zealand. The society designated the Ross Dependency Research Committee as the National Committee on Antarctic Research and appointed Dr E. I. Robertson, Vice Chairman

of the committee, the New Zealand delegate to SCAR. Scientifically, SCAR is broader based than its IGY counterpart, for, in addition to all the geophysical subjects, it is concerned with geology, cartography, biology, and physiology.

SCAR has met three times; first at The Hague in February 1958 when New Zealand was not represented; next at Moscow in August 1958 when Dr Robertson attended; and lastly at Canberra where Dr Robertson and Dr R. G. Simmers represented New Zealand.

Our participation in the activities of SCAR and being personally represented at its meetings has enabled New Zealand to make a signficant contribution to the international programme for Antarctic research. In addition, close personal contacts with leading scientists in other countries have been established. Therefore, the Ross Dependency Research Committee strongly favours continued support of SCAR.

In addition to the good international relations established through SCAR, New Zealand has fostered the cooperative spirit in the Antarctic and in New Zealand itself. Hallett Station, the joint United States/New Zealand base, is the unique example in Antarctica, of two countries joining to carry out an agreed scientific programme. At Scott Base, three American guest scientists are wintering over during 1959, whilst over the past summer seasons, visitors to the base have included Russian scientists from Mirny for several days, Australian, French, and Argentinian scientists. Two United States biologists were guest workers aboard H.M.N.Z.S. *Endeavour* during her Ross Sea cruise.

In New Zealand, a most successful Antarctic symposium was held in Wellington during February 1958, from which papers were published in the current year. This first Antarctic scientific meeting during IGY was attended by 40 scientists from six countries, and many New Zealand colleagues. Last season, many eminent United States scientists visited New Zealand for discussions of mutual interest. United States/New Zealand collaboration is not only evident in Antarctica, for in New Zealand, base facilities are provided for United States support unit at Christchurch. During March 1959, three New Zealand meteorologists attended a Symposium on Antarctic Meteorology in Melbourne, Australia.

PUBLICATIONS

Appended is the list of scientific papers on New Zealand Antarctic research, published by New Zealand scientists during the past year.

R. G. SIMMERS, Chairman.

N.Z. ANTARCTIC RESEARCH PUBLICATIONS DURING YEAR ENDING 31 MARCH 1959

General

Symposium on Antarctic Research. Wellington, 18–22 February 1958. (D.S.I.R.)

Antarctic Research. *Nature 182*:285–289. 1958. T. Hatherton.

N.Z. Antarctic Research Expeditions, December 1958 - December 1959. (D.S.I.R.)

Geology and Geophysics

A Radiocarbon Date for Penguin Colonization of Cape Hallett, Antarctica. *N.Z. J. Geol. Geophys. 1*:571–576. 1958. H. J. Harrington and I. C. McKellar.

Beaufort Island, Remnant of a Quaternary Volcano in the Ross Sea, Antarctica. *N.Z. J. Geol. Geophys. 1*:595–603. 1958. H. J. Harrington.

Nomenclature of Rock Units in the Ross Sea Region. *Nature 182*:290. 1958. H. J. Harrington.

Geological Investigations in South Victoria Land, Antarctic. Part 1 – Geology of Victoria Dry Valley. *N.Z. J. Geol. Geophys. 2*:120–136. 1959. P. N. Webb and B. C. McKelvey.

Thickness of the Earth's Crust in Antarctica. *Nature 183*:306–308. 1959. F. F. Evison, C. E. Ingham, and R. H. Orr.

Oceanography

Age Determination of Southern Ocean Waters. *Nature 181*:107–108. 1958. J. W. Brodie and R. W. Burling.

The Antarctic Convergence South of New Zealand. *N.Z. J. Geol. Geophys. 1*:577–594. 1958. D. M. Garner.

Eddies in Subantarctic Waters. *Proc. Antarctic Symposium* (Wellington). Oceanography; pp. 9–10 and fig. 1958. R. W. Burling.

A Shallow Shelf around Franklin Island in the Ross Sea, Antarctica. *N.Z. J. Geol. Geophys. 2*:108–119. 1959. J. W. Brodie.

Upper Atmosphere Physics

"Whistlers" in the Antarctic. *Nature 181*:1796–1797. 1958. L. H. Martin.

Presence of 6707A Radiation in the Twilight Sky. *Nature 182*:1598–1599. 1958. M. Gadsden and K. J. Salmon.

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